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# COAST FISHES

## PART II. THE PATAGONIAN REGION

By

J. R. NORMAN

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# COAST FISHES

## PART II. THE PATAGONIAN REGION[1]

### (INCLUDING THE STRAITS OF MAGELLAN AND THE FALKLAND ISLANDS)

By J. R. Norman
Department of Zoology, British Museum (Natural History)

(Plates I–V; Text-figs. 1–76)

## INTRODUCTION

The collections dealt with in this part of the report on the coast fishes include more than 3000 specimens, representing 84 species: of these 14 species prove to be new to science and 15 others were previously unrepresented in the National collection. The great majority of the specimens were obtained by the R.R.S. 'William Scoresby' during the trawling surveys of 1927–8 and 1931–2, the detailed reports of which are to be prepared by Mr E. R. Gunther. A certain number of specimens collected by the R.R.S. 'Discovery' in the neighbourhood of the Falkland Islands, and some others obtained by the 'William Scoresby' during her investigation of the Peru Current in 1931 are also included. The expedition has also received a fine series of littoral fishes from the Falkland Islands collected by Mr A. G. Bennett, with the assistance of Mr J. E. Hamilton. Mr Bennett's collection is accompanied by detailed notes on the occurrence and habits of the fishes, which have proved of great value, and many of which are included in this report. I take this opportunity of offering him my sincere thanks for his interest and assistance.

In order to compare the fish fauna of the Patagonian Region with that of the coasts of Argentina and Chile respectively it became necessary to obtain further collections from these countries, as the material in the British Museum, especially from the Chilean coast, was far from adequate. Dr Tomás L. Marini, Jefe División Piscicultura, Ministerio de Agricultura, Buenos Aires, has sent me a certain number of specimens taken off the coast of Buenos Aires; Mr E. J. MacDonagh, Jefe del Departamento de Zoología, Museo de la Plata, has sent examples of several species from northern Patagonia described by him, including several paratypes; and I have received as an exchange from the United States National Museum a small collection of fishes from Patagonia and Chile, being a part of that obtained by the 'Albatross' during her voyage through the Straits of Magellan in 1888. With regard to the Chilean coast, through the kind interest of Mr V. Cavendish Bentinck, of the British Embassy at Santiago, I have received several very interesting collections of marine fishes, which include examples of some species previously unrepresented in the British Museum collection. The following gentlemen were responsible for the collection and preservation of the specimens: Señor Luis A. Lagos, Director-General of Fisheries; Professor Carlos Oliver Schneider, Director of Concepción Museum; and Señor Pedro Golusda, Inspector of Fisheries at Lautaro. Mr Cavendish Bentinck has also sent a small but valuable series of specimens from Juan Fernandez, which had been made by Dr Juan Lengerich. To all the above-mentioned gentlemen and institutions my thanks are due and are gratefully tendered. Thanks are also due to the members of the Discovery Committee for permission to study these collections and to prepare this report, to Dr C. Tate Regan, F.R.S., for much help and advice given during its preparation, and to Lieut.-Col. W. P. C. Tenison, D.S.O., for the care and skill that he has displayed in the preparation of the illustrations. The colour sketches reproduced on Plate I are the work of Mr E. R. Gunther, who was in charge of the third of the trawling surveys made by the R.R.S. 'William Scoresby'.

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[1] For details as to the limits of this region see p. 137.

## SYSTEMATIC PART

### PETROMYZONIDAE

**Geotria australis**, Gray.

1851, *Chondropt.*, p. 142, pl. ii; Regan, 1911, *Ann. Mag. Nat. Hist.* (8) VII, p. 197; Lahille, 1915, *Anal. Mus. Nac. B. Aires*, XXVI, p. 370, figs.; Maskell, 1929, *Trans. N. Zealand Inst.*, LX, p. 167, figs.

*Hab.* Australia; New Zealand; Argentina, Patagonia and Chile.

No specimens of this species were obtained by the expedition, but Mr Hamilton has sent one to the British Museum, collected by him in the Falkland Islands in 1931–2. This is 395 mm. in total length, but it is not stated whether it was taken in the sea or in fresh water. I have also seen a young individual, 123 mm. long, from a brook in central Tierra del Fuego. Maskell has demonstrated that there is only one species of *Geotria* in New Zealand, and that various stages in its life history had formerly been regarded as distinct species. He suggests that this is perhaps the case also in Australia, Tasmania and South America. Direct comparison of South American material of all stages of growth with similar material from Australia and New Zealand is badly required.

### MYXINIDAE

Most authors have recognized only one species of *Myxine* from this region, and the inadequacy of many of the descriptions has made it impossible to give complete synonymies for the three species now defined. Lacepède's *Muraenoblenna olivacea*, from Magellan, is an undoubted *Myxine*, but cannot be referred with certainty to any of the three species. In 1842, Jenyns described *M. australis* from specimens collected by the 'Beagle' in Goree Sound and other parts of Tierra del Fuego, and although he makes no mention of such important characters as the number of teeth and pores, I have been able to examine the type[1] of the species and to ascertain its identity. In the eighth volume of his catalogue, published in 1870, Günther listed six examples of *M. australis*, collected at Sandy Point and Tyssen Islands by Dr R. O. Cunningham, and also described a new species (*M. affinis*), based upon a single dried and shrivelled example from an unknown locality.[2] In his synopsis of the genus published in 1899, Garman recognized two closely related species from this region, distinguished chiefly by differences in the numbers of teeth and pores and in the shape of the labrum (i.e. the two forms here identified as *australis* and *affinis*), as well as a third (*M. tridentiger*), distinguished by having the anterior three teeth confluent in each upper series.[3] The species described by Garman as *acutifrons*, however, proves to be the same as Jenyns' *australis*, and his *australis* is clearly the form here identified as *affinis*. In his revision of the genus published in 1913, Regan recognized only *tridentiger* and *australis* from this region, regarding *acutifrons* and *affinis* as synonyms of the latter species. Smitt (1898), Vaillant (1888), and others have regarded the southern Hag-fish as a mere variety of *Myxine glutinosa*, Linnaeus, of the northern hemisphere, and this is the view taken by Lahille, who in 1915 gave a detailed description of a number of specimens of *Myxine* from Ushuaia under the name *M. glutinosa* var. *olivacea*. Judging from his description, these specimens were of the species here named *M. affinis*. It is true that *M. australis*, Jenyns, is very closely related to *M. glutinosa*, but the latter appears to have a longer and more slender body and a labrum of somewhat different shape.

*Numbers of teeth in* M. australis *and* M. affinis

| *M. australis* | | *M. affinis* | |
|---|---|---|---|
| Length (mm.) | Teeth | Length (mm.) | Teeth |
| 100 | 8–8 | 165 | 9–9 |
| 230 | 8–8 | 290 | 10–9 |
| 230 | 8–9 | 305 | 10–10 |
| 230 | 8–9 | 320 | 10–10 |
| 245 | 8–9 | 325 | 10–10 |
| 250 | 8–9 | 330 | 11–11 |
| 250 | 8–9 | 340 | 10–10 |
| 250 | 8–9 | 340 | 10–10 |
| 275 | 8–9 | 370 | 10–10 |
| 285 | 8–9 | 375 | 10–11 |
| 285 | 8–9 | 400 | 10–10 |
| 285 | 8–10 | 420 | 10–10 |
| 290 | 8–9 | 430 | 11–11 |
| 320 | 8–9 | 490 | 11–11 |
| 360 | 8–9 | | |
| 380 | 8–9 | | |

[1] I am indebted to Dr C. Forster Cooper for the loan of this fish, which is preserved in the Zoological Museum at Cambridge. It is 285 mm. long, and is in fair condition, although it is difficult to count the pores along the body.

[2] It is quite impossible to count the pores on the body in the type of this species, but as the teeth number 11/11 it has been assumed that this is the same as the form here described with dark coloration, short broad labrum, and higher numbers of teeth and pores.

[3] The fusion of three teeth is given by Günther (1870) as a character of *M. australis*, but occurs in only one example from Sandy Point, the specimen selected by Regan as the type of *M. tridentiger*.

*Numbers of abdominal pores in* M. australis *and* M. affinis

| *M. australis* | | *M. affinis* |
|---|---|---|
| × | 56 | — |
| × | 57 | — |
| × | 58 | — |
| × × | 59 | — |
| × × × × | 60 | — |
| × × | 61 | — |
| — | 62 | — |
| × | 63 | × × × × |
| × | 64 | × × |
| — | 65 | — |
| — | 66 | — |
| — | 67 | × × |
| — | 68 | × |
| — | 69 | × |

**Myxine australis, Jenyns.**

1842, *Zool. 'Beagle'*, Fish., p. 159; Hussakof, 1914, *Bull. Amer. Mus. Nat. Hist.*, xxxiii, p. 85.

*Myxine australis* (part), Günther, 1870, *Cat. Fish.*, viii, p. 511; Cunningham, 1871, *Trans. Linn. Soc. London*, xxvii, p. 473; Regan, 1913, *Ann. Mag. Nat. Hist.* (8) xi, p. 397.

*Myxine acutifrons*, Garman, 1899, *Mem. Mus. Comp. Zoöl.*, xxiv, p. 347, pl. lxviii, fig. 6.

St. WS 763. 16. x. 31. 44° 14′ S, 63° 28′ W. Seine net attached to back of trawl, 87–82 m.: 1 specimen, 100 mm.

St. WS 776. 3. xi. 31. 46° 18′ 15″ S, 65° 02′ 15″ W. Conical dredge, 107 m.: 1 specimen, 230 mm.

St. WS 789. 3. xii. 31. 45° 17′ S, 64° 22′ W. Seine net attached to back of trawl, 95–93 m.: 7 specimens, 120–330 mm.

Six branchial pouches. Eight teeth in the first series, 8 or 9 in the second, the 2 most anterior united. Pores 30–36 + 56–64 + 9–12. Length of head $3\frac{1}{4}$ to about $3\frac{3}{5}$ in the total length. Brownish or olivaceous above, paler below.

*Hab.* Coasts of Patagonia and southern Chile; Falkland Islands; South Shetland Islands.

In addition to the above, Mr Bennett has sent 2 specimens from the Falklands: one (360 mm.) from Stanley Harbour, Low Spring Tide, collected in October 1932; the other (380 mm.) from Salvador Waters, collected in April 1932. Mr Hamilton has sent another from Stanley Harbour (360 mm.), collected in January 1925. There are 6 specimens (250–320 mm.) in the British Museum from the South Shetlands, Falklands, Straits of Magellan, Tyssar Islands and Cockle Cove.

**Myxine affinis, Günther.** "Chkoutaouélik."

? *Muraenoblenna olivacea*, Lacepède, 1803, *Hist. Nat. Poiss.*, v, p. 652.

*Myxine affinis*, Günther, 1870, *Cat. Fish.*, viii, p. 511.

*Myxine australis* (part), Günther, 1870, *t.c.*, p. 511; Cunningham, 1871, *Trans. Linn. Soc. London*, xxvii, p. 473; Regan, 1913, *Ann. Mag. Nat. Hist.* (8) xi, p. 397.

*Myxine australis*, Vaillant, 1888, *Miss. Sci. Cap Horn.*, vi. Zool., Poiss., p. 32; Steindachner, 1898, *Zool. Jahrb.*, Suppl. iv, p. 334; Garman, 1899, *Mem. Mus. Comp. Zoöl.*, xxiv, p. 345, pl. lxviii, fig. 8; Thompson, 1916, *Proc. U.S. Nat. Mus.*, l, p. 419.

*Myxine glutinosa* forma *australis*, Smitt, 1898, *Bih. Sv. Vet.-Akad. Handl.*, xxiv, iv, No. 5, p. 75.

*Myxine glutinosa* var. *olivacea*, Lahille, 1915, *Anal. Mus. Nac. B. Aires*, xxvi, p. 362, figs. 1–3.

St. WS 582. 30. iv. 31. 53° 42′ 30″ S, 70° 55′ W. Dip net, 12 m.: 4 specimens, 290–420 mm.

Six branchial pouches. 10 or 11 (9 in young) teeth in the first series, 9 to 11 (generally 10 or 11) in the second, the 2 most anterior united. Pores 28–34 + 63–69 + 9–13. Length of head 3¼ to 3¾ in the total length. Labrum shorter and more obtusely pointed than in *M. australis*. Coloration of freshly preserved specimens purplish brown, with a narrow area of sharply contrasted yellowish white along the ventral surface.

*Hab.* Coasts of Patagonia and southern Chile.

In addition to the above there are 8 specimens (165–490 mm.) in the British Museum from Orange Bay, Cape Gregory, Puerto Bueno, Messier Channel and Sandy Point, including the type of the species.

**Myxine tridentiger**, Garman.

*Myxine australis* (part), Günther, 1870, *Cat. Fish.*, VIII, p. 511; Günther, 1887, *Deep-Sea Fish. 'Challenger'*, p. 267.

*Myxine tridentiger*, Garman, 1899, *Mem. Mus. Comp. Zoöl.*, XXIV, p. 345; Regan, 1913, *Ann. Mag. Nat. Hist.* (8) XI, p. 396.

Six branchial pouches. Ten teeth in each series, the 3 most anterior in the first series and the 2 most anterior in the second series united. Pores 22 + 62 + 9. Length of head 3⅔ in the total length. Left branchial aperture widely separated from that of the oesophageal duct.

*Hab.* Straits of Magellan.

Known only from the unique holotype, 460 mm. in total length, from Sandy Point.

## LAMNIDAE

**Cetorhinus maximus** (Gunner).

During the summer of 1926 or 1927 a large shark was found dead on the north coast of East Falkland, north by west of Stanley, about midway between McBride's Head and the entrance of Salvador Waters. The length was said to be more than 30 ft. A strip of teeth was taken from the jaws and sent to the British Museum for identification.[1] This was an undoubted Basking Shark, the southern representative of the common *Cetorhinus maximus* of the northern hemisphere, and may prove to be a distinct species.

A shark observed by Mr J. E. Hamilton in 1936 probably belongs to this species. He says:

> I watched it for about forty minutes as it cruised about on the edge of a *Macrocystis* bed off Cape Dolphin. It had an anterior dorsal fin which may have been thirty inches in height and a much smaller posterior one. The colour was very dark grey or black with a pale mark on the larger dorsal fin. I estimate the length of the fish at well over twenty feet.

The Basking Shark has been recorded from various localities in Australia and New Zealand,[2] but I can find only one record from southern South America.[3]

---

[1] Norman, 1933, *Proc. Zool. Soc.*, p. 1121.

[2] Whitley, 1934, *Mem. Queensland Mus.*, x, p. 196. Whitley has replaced the name *Cetorhinus*, Blainville (1816) by *Halsydrus*, Fleming (1809), but as the latter name was given to a supposed "sea serpent" of the Orkney Islands, which afterwards was said to be a Basking Shark, there would appear to be little justification for interfering with a well-established name. *Tetroras*, Rafinesque (1810), is of very doubtful validity.

[3] Lahille, 1928, *Anal. Mus. Nac. B. Aires*, XXXIV, p. 325—Golfo Nuevo, Argentina.

## SCYLIORHINIDAE

**Scyliorhinus (Halaelurus) bivius** (Smith).

"Kayachaï" or "Kayachaya"; "Pintarroja".

*Scyllium bivium*, Smith, 1837, *Proc. Zool. Soc.*, p. 85 (*nomen nudum*); Müller and Henle, 1841, *Plagiost.*, p. 8; Duméril, 1865, *Hist. Nat. Poiss.*, I, p. 321; Günther, 1870, *Cat. Fish.*, viii, p. 405.

*Scyllium brevicolle*, Philippi, 1887, *An. Univ. Chile*, lxxi, p. 558, pl. vii, fig. 5.

*Scyllium gayi*, Philippi, 1887, *Zool. Garten*, p. 86.

*Scyllium chilense* (*non* Guichenot), Günther, 1880, *Shore Fish. 'Challenger'*, p. 19; Vaillant, 1888, *Miss. Sci. Cap Horn.*, vi. Zool., Poiss., p. 10, pl. i, fig. 1; Perugia, 1891, *Ann. Mus. Civ. stor. nat. Genova* (2) x [xxx], p. 608; Berg, 1895, *Anal. Mus. Nac. B. Aires*, iv, p. 6; Dollo, 1904, *Rés. Voy. 'Belgica'*, Poiss., p. 79.

*Scylliorhinus chilensis*, Smitt, 1898, *Bih. Sv. Vet.-Akad. Handl.*, xxiv, iv, No. 5, p. 72; Lönnberg, 1907, *Hamb. Magalh. Sammelr.*, Fische, p. 4; Roule, Angel and Despax, 1913, *Deux. Expéd. Antarct. Franç.*, Poiss., p. 2.

*Scylliorhinus chilensis* (part), Delfin, 1901, *Cat. Peces Chile*, p. 15.

*Scyliorhinus bivius*, Regan, 1908, *Ann. Mag. Nat. Hist.* (8) I, p. 461; Lahille, 1921, *Enum. Peces Cart. Argent.*, p. 12.

*Halaelurus bivius*, Garman, 1913, *Mem. Mus. Comp. Zoöl.*, xxxvi, p. 86.

*Scylium bivium*, Lahille, 1928, *Anal. Mus. Nac. B. Aires*, xxxiv, p. 302, pl. ii, text-figs. 3–5.

St. WS 583. 2. v. 31. 53° 39′ S, 70° 54′ 30″ W. Small beam trawl, 14–78 m.: 3 specimens, 125–170 mm.

St. WS 586. 8. v. 31. 48° 27′ 30″ S, 74° 23′ 30″ W. Hand line, 22 m.: 2 male specimens, 395, 410 mm.

Snout obtusely pointed, its praeoral length about equal to distance between outer edges of nasal flaps; latter without cirri, widely separated, acutely pointed and with notched posterior edges; longitudinal diameter of eye $3\frac{4}{5}$ to $4\frac{1}{2}$ in distance from tip of snout to first gill-opening. Lower lip not overlapped by the upper; a distinct labial fold at the angle of the mouth, extending along the lower jaw about $\frac{1}{2}$ the distance to the symphysis. Denticles all small; no enlarged tubercles on the back. First dorsal a little smaller than second, originating above end of base of pelvics; base $\frac{1}{3}$ to $\frac{2}{5}$ of its distance from the second. Base of anal $1\frac{1}{2}$ to $1\frac{4}{5}$ as long as that of first dorsal, shorter than its distance from caudal. Pectoral with rounded angles, extending $\frac{3}{5}$ to $\frac{2}{3}$ the distance from its origin to that of pelvics. Pelvic fins not united. Back with black blotches or transverse bars; upper parts with rounded blackish spots and usually with some pale spots.

*Hab.* Coasts of Argentina, Patagonia and southern Chile.

In addition to the above, there are 8 specimens (280–750 mm.) in the British Museum from various localities in the Straits of Magellan, including the type of the species (a stuffed skin). Two egg-capsules collected by the 'Challenger' probably belong to this species.

This species is closely related to *S. chilensis* (Guichenot), from the coasts of Chile and Peru, in which the anal fin is $1\frac{1}{3}$ times as long as the first dorsal, which measures $\frac{2}{5}$ to nearly $\frac{1}{2}$ of its distance from the second, the longitudinal diameter of the eye is about 6 in the distance from tip of snout to first gill-opening, there are generally two series of tubercles on the back from the head to the first dorsal fin, and the nasal flaps have a different shape. The exact range of *S. chilensis* is doubtful, but it probably does not extend southwards into the Patagonian region as here defined. The British Museum has received nine examples of this species from Lota, through Mr V. Cavendish Bentinck.

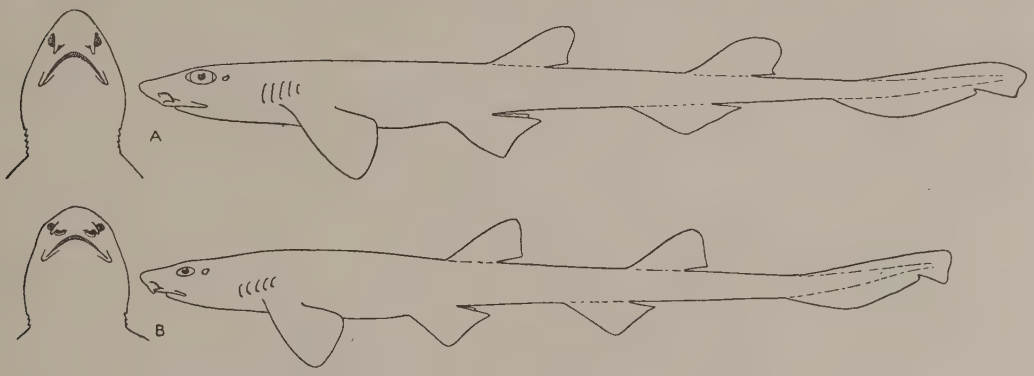

Fig. 1. A, *Scyliorhinus* (*Halaelurus*) *bivius*; B, *S.* (*Halaelurus*) *chilensis*. × $\frac{1}{8}$.

## SQUALIDAE

**Squalus lebruni** (Vaillant). "Kaïss"; "Kaïgis".

?? *Squalus fernandinus*, Molina, 1782, *Sag. stor. nat. Chili*, p. 229.
*Acanthias vulgaris* (part), Günther, 1870, *Cat. Fish.*, VIII, p. 418.
*Acanthias vulgaris* (*non* Risso), Cunningham, 1871, *Trans. Linn. Soc. London*, XXVII, p. 473.
*Acanthias lebruni*, Vaillant, 1888, *Miss. Sci. Cap Horn*, VI. Zool., Poiss., p. 13, pl. i, fig. 2.
*Squalus lebruni*, Berg, 1895, *Anal. Mus. Nac. B. Aires*, IV, p. 6; Delfin, 1901, *Cat. Peces Chile*, p. 22.
*Squalus acanthias*, Delfin, 1901, *t.c.*, p. 21; Lönnberg, 1907, *Hamb. Magalh. Sammelr.*, Fische, p. 5.
*Squalus fernandinus*, Regan, 1908, *Ann. Mag. Nat. Hist.* (8) II, p. 46; Hussakof, 1914, *Bull. Amer. Mus. Nat. Hist.*, XXXIII, p. 85; Thompson, 1916, *Proc. U.S. Nat. Mus.*, L, p. 420; Lahille, 1921, *Enum. Peces Cart. Argent.*, p. 16; Phillipps, 1929, *N. Zealand J. Sci. Tech.*, X, p. 223, fig. 3.
*Squalus kirkii*, Phillipps, 1931, *N. Zealand J. Sci. Tech.*, XII, p. 361.

St. WS 90. 7. iv. 27. 13 miles N 83° E of Cape Virgins Light, Argentine Republic. Commercial otter trawl, 82–81 m.: 1 male specimen, 600 mm.

Very closely allied to *S. acanthias* of the North Atlantic and Mediterranean, but with a shorter snout, the praeoral length equal to or less than the distance from eye to first gill-opening, the praeocular length about equal to the distance from anterior edge of eye to spiracle. Dorsal fin-spines longer, and pale spots on body larger than in *S. acanthias*.

*Hab.* Southern Australia and Tasmania; New Zealand; Argentina, Patagonia and Chile.

I have compared the above specimen with 3 (550–800 mm.) from Tasmania and a male specimen (760 mm.) of *S. kirkii* received from Mr W. J. Phillipps and am unable to detect any important differences. There would, therefore, seem to be only one spotted species of Spiny Dogfish in the southern hemisphere. I am unable to say whether the unspotted form from Australia and Tasmania (*S. megalops*) is identical with that from New Zealand (*S. griffini*) and that from South America (*S. fernandezianus*), as the material in the British Museum collection consists only of a few adult and half-grown specimens from Tasmania, some young examples from New Zealand, and a stuffed specimen of 900 mm. from Juan Fernandez. For the present, the species, which may occur in the Patagonian region, may be known as *S. fernandezianus* (Guichenot).

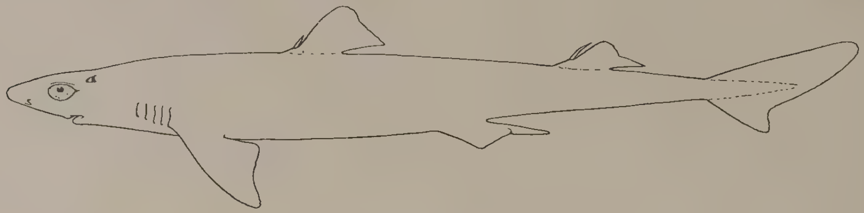

Fig. 2. *Squalus lebruni.* × $\frac{1}{5}$.

## SQUATINIDAE

**Squatina armata (Philippi).**

*Rhina armata*, Philippi, 1887, *An. Univ. Chile*, LXXI, p. 561, pl. vii, fig. 1.

Folds at sides of head not produced into lobes. Outer nasal flap with entire edges; inner flap with two simple prolongations, the outer of which has a broad fringed lobe at its base. Distance between the spiracles about equal to the interocular width, which is $4\frac{1}{2}$ times the longitudinal diameter of the eye. Outer angle of pectoral nearly a right angle; distance from anterior angle to posterior end of base about $\frac{3}{5}$ the extreme length of the fin. Pelvic not reaching the vertical from origin of first dorsal. Width of tail (at the base) about $\frac{1}{4}$ of its length. Base of first dorsal about $\frac{1}{2}$ its height, which is a little more than its distance from the second; second dorsal a little shorter, but scarcely lower than the first; interspace between the dorsals a little less than the distance from second dorsal to caudal, much less than the distance from base of tail to origin of first dorsal. Posterior edge of caudal fin somewhat notched, the upper lobe nearly vertically truncate, the lower rounded. Upper surface with small, pointed denticles, each with 3 keels; a middorsal series of large denticles, with one or more rows of smaller enlarged denticles on either side; small groups of spines in front of and behind the eyes, and two small groups on tip of snout on either side of median line of head; a pair of spines, well separated from each other, between the spiracles; small imbricated denticles at outer edges of paired fins, extending on to their lower surfaces and, on the pectoral, forming an inferior marginal strip equal in width to about $\frac{1}{3}$ the interocular space; denticles on lower surface of tail not extending forward to its base; lower surface of head and abdomen naked. Greyish brown, with a few small round whitish spots.

*Hab.* Argentina; Chile.

Described from two specimens, a male of 470 mm. and a female of 450 mm.; presented to the British Museum by Dr Tomás L. Marini.

It is with some hesitation that I have identified these specimens with the Chilean species, known only from Philippi's rather poor description and figure.[1] It appears to be nearly related to *S. aculeata* (Cuvier), differing chiefly in the smaller eye, less complicated nasal flaps, shorter pelvic fins, differently shaped pectorals, and in the coloration. From *S. japonica*, Bleeker, another species with a median series of enlarged denticles, it may be readily distinguished by having the distance between the spiracles equal to instead of greater than the interocular width.

## TORPEDINIDAE

**Discopyge tschudii,** Heckel.

1846, in Tschudi, *Fauna Peru.*, Ichth., p. 33, pl. vi; Duméril, 1865, *Hist. Nat. Poiss.*, I, p. 521; Günther, 1870, *Cat. Fish.*, VIII, p. 454; Berg, 1895, *Anal. Mus. Nac. B. Aires*, IV, p. 10; Steindachner, 1898, *Zool. Jahrb.*, Suppl. IV, p. 332, pl. xxi, fig. 14; Garman, 1913, *Mem. Mus. Comp. Zoöl.*, XXXVI, p. 303.

St. WS 776. 3. xi. 31. 46° 18′ 15″ S, 65° 02′ 15″ W. Commercial otter trawl, 107–99 m.: 4 female specimens, 250–305 mm.

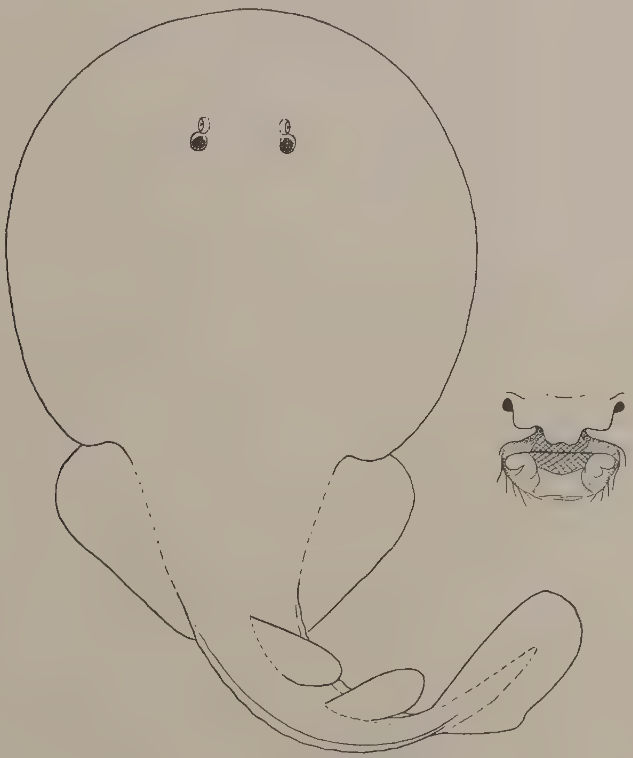

Fig. 3. *Discopyge tschudii.* × ½.

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[1] The specimen from Peru described by Evermann and Radcliffe (1917, *Bull. U.S. Nat. Mus.*, XCV, p. 11) may have belonged to this species.

*Hab.* Coasts of Argentina, Patagonia, Chile and Peru.

This species, which was previously unrepresented in the British Museum collection, appears to range from the mouth of the Rio Plata to the middle of the coast of Peru. In addition to the above, I have received a female, 320 mm. long, from Buenos Aires (Marini), and a male of 410 mm. and 2 females of 270 and 320 mm. from Coronel, Chile (Cavendish Bentinck).

## RAJIDAE

A large series of specimens of *Raja* and *Psammobatis* was obtained during the trawling surveys, and, except for one of the new species of *Raja*, which is based upon a single example, each species is represented by a fairly good range of material. The following egg-capsules and embryos are indeterminable and may belong to either genus:

St. WS 233. 5. vii. 28. 49° 25′ S, 59° 45′ W. Commercial otter trawl, 185–175 m.: 1 egg-capsule.

St. WS 583. 2. v. 31. 53° 39′ S, 70° 54′ 30″ W. Small beam trawl, 14–78 m.: 2 egg-capsules, 2 embryos.

St. WS 764. 17. x. 31. 44° 38′ 45″ S, 61° 49′ 30″ W. Commercial otter trawl, 110–104 m.: 1 egg-capsule.

St. WS 776. 3. xi. 31. 46° 18′ 15″ S, 65° 02′ 15″ W. Commercial otter trawl, 107–99 m.: 1 embryo.

St. WS 787. 7. xii. 31. 48° 44′ S, 65° 24′ 30″ W. Commercial otter trawl, 106–110 m.: 1 embryo.

St. WS 800. 21–22. xii. 31. 48° 15′ 45″ S, 62° 09′ 52″ W. Commercial otter trawl, 139–137 m.: 1 embryo.

St. WS 805. 6. i. 32. 50° 10′ 15″ S, 63° 29′ W. Commercial otter trawl, 148 m.: 2 embryos.

St. WS 825. 28–29. i. 32. 50° 50′ S, 57° 15′ 15″ W. Commercial otter trawl, 135–144 m.: 1 embryo.

### REVISION OF THE PATAGONIAN SPECIES OF *RAJA*

### *Key to the species*[1]

I. Terminal parts of lateral line tubules on lower surface pigmented, appearing as small blackish spots and streaks; snout long, acutely pointed, length 3¼ to 3¾ (2¾ to 3¼ in young) times eye + spiracle; vent much nearer end of tail than tip of snout; a single large nuchal spine ... ... ... ... ... ... ... ... ... ... *flavirostris.*

II. No pigment spots or streaks on lower surface; snout shorter, not acutely pointed, length never more than 3¼ times eye + spiracle.
  A. One to three pairs of enlarged scapular spines; spines scattered over disc of moderate size and fairly well separated; a continuous series of median spines from nuchal region to first dorsal fin.
    1. Ocular spines and median spines on disc and tail very strong, ribbed; spines scattered over disc rather large, with stellate bases; 12 to 15 median spines on back; mixopterygia short, stout ... ... ... ... ... ... ... ... *doello-juradoi.*
    2. Ocular spines and median spines on disc and tail smaller, not ribbed; spines scattered over disc smaller, without distinctly stellate bases; 25 to 42 median spines on back; mixopterygia rather long, slender.
      *a.* Small spines scattered over greater part of disc; eye + spiracle 1⅖ to 1¾ in length of snout ... ... ... ... ... ... ... ... *macloviana.*

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[1] I am unable to place *R. cynosbatus* from the published description (Philippi, 1896, *An. Univ. Chile*, XCIII, p. 385). The type was a male, 500 mm. long (width of disc 310 mm.).

*b.* Small spines mainly confined to anterior parts of disc and middle of back; eye + spiracle 2 to 2⅖ in length of snout.
(i) Ocular spines present; 26 to 30 median spines on back; 2 (or 3) pairs of scapular spines; coloration mottled, each pectoral with a large double ocellus-like spot ... ... ... ... ... ... ... ... *magellanica.*
(ii) No ocular spines; 42 median spines on back; one pair of scapular spines; coloration nearly uniformly greyish brown ... ... ... *multispinis.*

B. No enlarged scapular spines; spines scattered over disc smaller and closer together; no ocular spines.
1. Internasal width 2½ to 2¾ in praeoral length of snout; eye + spiracle 2⅔ to 3⅓ in length of snout ... ... ... ... ... ... ... ... *scaphiops.*
2. Internasal width twice or less than twice (occasionally 2⅕) in praeoral length of snout; eye + spiracle 1¾ to about 3 in length of snout.
*a.* Disc with small, rounded, white spots; median spines on tail very strong; median series on back continuous, or 2 or 3 nuchal spines separated from remainder; mixopterygia rather long, slender, scarcely expanded distally, without projecting process ... ... ... ... ... ... ... ... ... *albomaculata.*
*b.* Disc without small, round, white spots; median spines less strong; mixopterygia (in *brachyurops*) rather shorter, expanded distally, with a small projecting process.
(i) Vent (except in young) nearer to end of tail than to tip of snout; tail uniformly white below or with a few greyish spots; 20 to 34 rows of teeth in upper jaw ... ... ... ... ... ... ... ... ... *brachyurops.*
(ii) Vent nearer to tip of snout than to end of tail; tail with parts of the lower surface stained with greyish brown; 30 to 36 rows of teeth in upper jaw *griseocauda.*

## Raja flavirostris, Philippi.

?? *Raia chilensis*, Guichenot, 1848–9, in Gay, *Hist. Chile*, Zool. II, p. 367; Philippi, 1892, *An. Mus. Nac. Chile*, I, Zool., p. 1.

*Raja flavirostris*, Philippi, 1892, *t.c.*, p. 3, pl. i, fig. 2; Garman, 1913, *Mem. Mus. Comp. Zoöl.*, XXXVI, p. 361; Fowler, 1927, *Proc. Acad. N.S. Philad.*, LXXVIII, p. 277.

*Raja oxyptera*, Philippi, 1892, *t.c.*, p. 4; pl. ii, fig. 1; Lönnberg, 1907, *Hamb. Magalh. Sammelr.*, Fische, p. 6.

*Raja latastei*, Delfin, 1902, *Revist. Chil.*, VI (4), p. 264, pl. xi.

*Raia stabuliforis*, Marini, 1928, *Physis*, IX, p. 137, fig. 3.

*Raia brevicaudata*, Marini, 1933, *Physis*, XI, p. 329.

St. WS 77. 12. iii. 27. 51° 01′ S, 66° 31′ 30″ W. Commercial otter trawl, 110–113 m.: 1 female specimen, 480 mm. (width of disc 400 mm.).

St. WS 79. 14. iii. 27. 51° 01′ 30″ S, 64° 59′ 30″ W. Commercial otter trawl, 132–131 m.: 1 male specimen, 365 mm. (width of disc 320 mm.), 1 female specimen, 345 mm. (width of disc 285 mm.).

St. WS 95. 17. iv. 27. 48° 58′ 15″ S, 64° 45′ W. Commercial otter trawl, 109–108 m.: 1 male specimen, 285 mm. (width of disc 225 mm.).

St. WS 214. 31. v. 28. 48° 25′ S, 60° 40′ W. Commercial otter trawl, 208–219 m.: 1 female specimen, 310 mm. (width of disc 258 mm.).

St. WS 236. 6. vii. 28. 46° 55′ S, 60° 40′ W. Commercial otter trawl, 272–300 m.: 1 male specimen, 610 mm. (width of disc 490 mm.).

St. WS 763. 16. x. 31. 44° 14′ S, 63° 28′ W. Commercial otter trawl, 87–82 m.: 1 male specimen, 180 mm. (width of disc 140 mm.).

St. WS 765. 17. x. 31. 45° 07′ S, 60° 28′ 15″ W. Commercial otter trawl, 113–118 m.: 1 male specimen, 360 mm. (width of disc 280 mm.).

St. WS 789. 13. xii. 31. 45° 17′ S, 64° 22′ W. Commercial otter trawl, 95–93 m.: 2 male specimens, 325–330 mm. (width of disc 255, 260 mm.).

St. WS 790. 14. xii. 31. 45° 28′ 52″ S, 63° 40′ 37″ W. Commercial otter trawl, 99–101 m.: 3 male specimens, 240–405 mm. (width of disc 180–335 mm.), 5 female specimens, 250–480 mm. (width of disc 160–380 mm.).

St. WS 792. 15. xii. 31. 45° 49′ 30″ S, 62° 20′ 15″ W. Commercial otter trawl, 102–106 m.: 1 female specimen, 270 mm. (width of disc 210 mm.).

St. WS 815. 13. i. 32. 51° 51′ 45″ S, 65° 44′ W. Commercial otter trawl, 132–162 m.: 1 male specimen, 720 mm. (width of disc 520 mm.).

St. WS 835. 2. ii. 32. 53° 05′ 30″ S, 68° 06′ 30″ W. Small beam trawl, 14–16 m.: 1 male specimen, 165 mm. (width of disc 120 mm.).

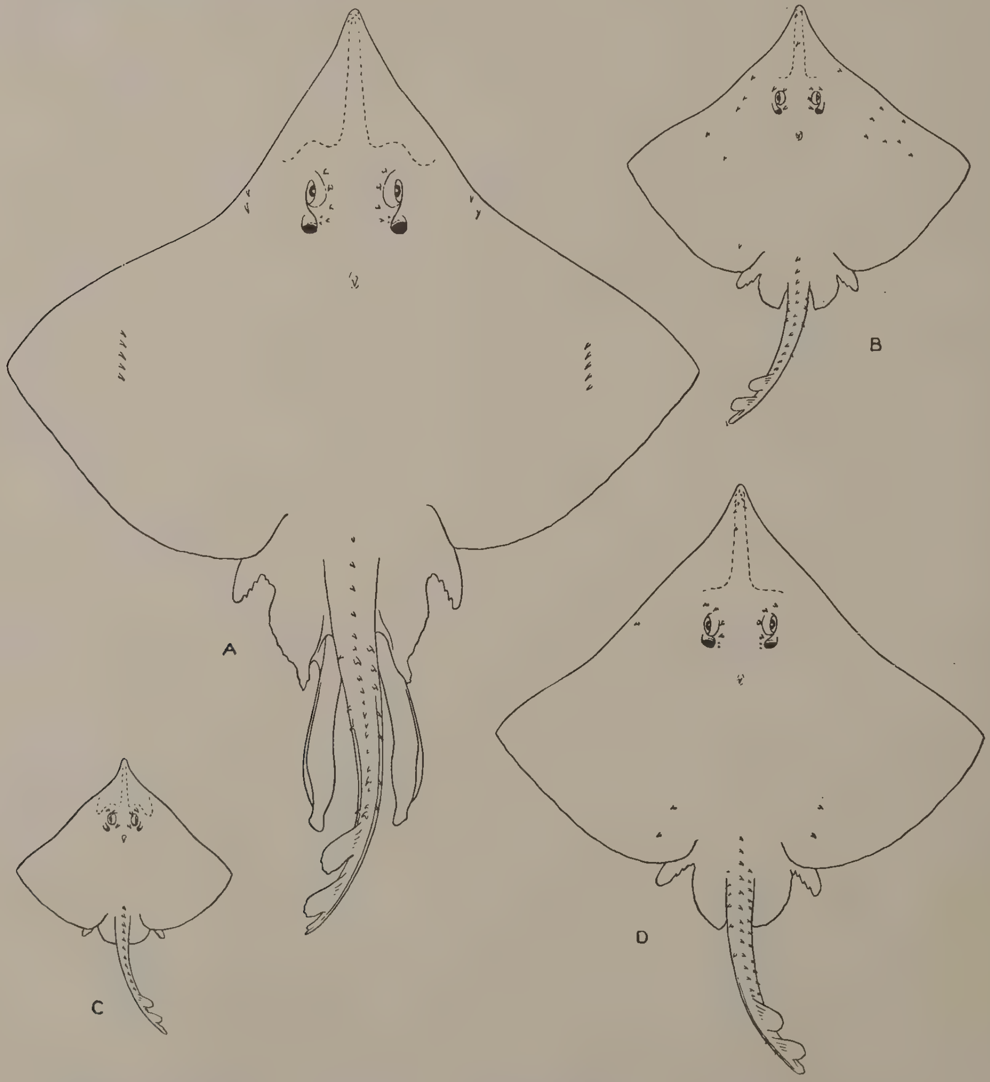

Fig. 4. *Raja flavirostris*. A, adult male; B, half-grown male; C, young male; D, female. × $\frac{1}{5}$.

Disc broader than long, its width $\frac{3}{4}$ to more than $\frac{4}{5}$ of the total length; anterior margins a little undulated; outer angles obtusely pointed, nearly forming right angles. Vent much nearer to end of tail than to tip of snout. Snout acutely pointed, its length $\frac{1}{5}$ (young) to more than $\frac{1}{4}$ width of disc and $2\frac{3}{4}$ (young) to $3\frac{3}{4}$ times diameter of eye + spiracle, which is about equal to interorbital width. Internasal width about 2 in praeoral length of snout. Mouth nearly straight; teeth fairly close-set, with more or less pointed crowns; 25 to 35 rows in the upper jaw. Upper surface mainly smooth, but both sexes sometimes with a few scattered spines on the disc and on the rostral process, these being more strongly developed in males; rostral process in large specimens more or less covered with asperities; generally 1 (sometimes 3 to 5) strong praeocular spine, another above the middle of the orbit, 1 postocular spine, and 1 or 2 smaller ones (absent in young) above each spiracle; a single strong median nuchal spine; no scapular spines; no median spines on disc, but a series of 12 to 23 enlarged spines extending from opposite the hinder angle of the pectoral fin to the first dorsal fin; all but very young specimens with an irregular row of spines on each side of the median series on the tail, and sometimes with a few additional spines at the edges of the tail; a large male has a single series of alar spines. Lower surface smooth, except for rough areas on rostral process and on margins of snout; these areas increase in size with age, and in large specimens the whole lower surface of the snout is rough; sometimes a few scattered buckler-like spines on disc. Dorsal fins close to end of tail, separated by a spine. Brownish or greyish; more or less uniform or with numerous indistinct pale spots; some larger specimens with traces of a large circular ocellus near the middle of the base of each pectoral; lower surface yellow or white; sometimes greyish; terminal parts of lateral line tubules pigmented, appearing as small blackish spots and streaks.

*Hab.* Argentina; Patagonian-Falklands region; Straits of Magellan; Chile.

In addition to the above, I have received a specimen of *R. brevicaudata* from Buenos Aires (Marini). This is a male, 450 mm. in total length (width of disc 360 mm.). I have been unable to examine any Chilean material of this long-snouted form, but have little doubt that the specimens described here are identical with the large male and female described by Philippi as *Raja oxyptera* and *R. flavirostris* respectively. *R. flavirostris* is most nearly related to *R. batis* from Europe and South Africa and *R. stabuliforis* from the east coast of North America.

**Raja doello-juradoi**, Pozzi. (Plates II, III.)[1]

1935, *Physis*, XI, p. 491.

St. WS 98. 18. iv. 27. 49° 54′ 15″ S, 60° 35′ 30″ W. Commercial otter trawl, 173–171 m.: 1 female specimen, 380 mm. (width of disc 280 mm.).

St. WS 215. 31. v. 28. 47° 37′ S, 60° 50′ W. Net (7 mm. mesh) attached to back of trawl, 219–146 m.: 1 male specimen, 100 m. (width of disc 60 mm.).

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[1] This species had been described by me as new to science, but after this report had gone to press my attention was drawn to Pozzi's preliminary description of what appears to be the same Ray. His specimens were taken off the coast of northern Argentina (39″ 12′ S; 56′ 00° 06″ W). He notes that *R. doello-juradoi* differs from *R. scabrata*, Garman, principally "por el menor número de espinas de la serie dorsal; el mayor número de los grandes acúleos supra-escapulares; menor longitud del apéndice caudal en función al tamaño del disco y coloración general".

St. WS 218. 2. vi. 28. 45° 45′ S, 59° 35′ W. Commercial otter trawl, 311–247 m.: 1 female specimen, 300 mm. (width of disc 230 mm.).

St. WS 245. 18. vii. 28. 52° 36′ S, 63° 40′ W. Commercial otter trawl, 304–290 m.: 1 male specimen, 430 mm. (width of disc 330 mm.).

St. WS 783. 5. xii. 31. 50° 08′ S, 59° 50′ W. Commercial otter trawl, 155–159 m.: 1 male specimen, 200 mm. (width of disc 150 mm.).

St. WS 794. 17. xii. 31. 46° 12′ 37″ S, 60° 59′ 15″ W. Commercial otter trawl, 123–126 m.: 1 female specimen, 260 mm. (width of disc 200 mm.).

St. WS 795. 18. xii. 31. 46° 14′ S, 60° 24′ W. Commercial otter trawl, 157–161 m.: 1 male specimen, 195 mm. (width of disc 145 mm.), 1 female, 210 mm. (width of disc 150 mm.).

St. WS 817. 14. i. 32. 52° 23′ S, 64° 19′ W. Commercial otter trawl, 202–238 m.: 1 male specimen, 330 mm. (width of disc 260 mm.).

St. WS 820. 18. i. 32. 52° 53′ 15″ S, 61° 51′ 30″ W. Commercial otter trawl, 351–367 m.: 1 female specimen, 225 mm. (width of disc 170 mm.).

St. WS 851. 11. ii. 32. 51° 39′ 30″ S, 62° 01′ 15″ W. Commercial otter trawl, 221–197 m.: 2 male specimens, 195, 200 mm. (width of disc 140, 145 mm.).

Disc broader than long, its width about $\frac{3}{4}$ of the total length; anterior margins in females and immature males more or less undulated but scarcely emarginate; in mature males these margins are more or less distinctly notched; outer angles of disc obtusely pointed. Vent nearer to end of tail than to tip of snout. Snout scarcely projecting, its length a little more than $\frac{1}{7}$ (young) to about $\frac{1}{6}$ width of disc; interorbital width about equal to longitudinal diameter of eye; length of eye + spiracle $1\frac{1}{3}$ times to about twice in that of snout. Internasal width $\frac{2}{3}$ praeoral length of snout. Mouth nearly straight; teeth with pointed crowns, sometimes worn down so that the teeth appear flat; 28 to 34 rows in the upper jaw. Upper surface of disc with scattered spines, each sharply pointed and usually with a stellate base; hinder parts of pectoral fins smooth; in adult males and perhaps also in mature females these scattered spines are relatively smaller; a single strong praeocular, and 2 postocular spines, of which the more posterior is the larger; a large median spine on the back in the suprascapulary region and a single nuchal spine a little further forward; 3 smaller scapular spines, of which the innermost is the smallest; a series of 12 to 15 strong median spines extending from a point well in front of the hinder angle of the pectoral fin to the first dorsal fin; a row of much smaller spines on either side of the median series and a narrow area of asperities along each edge of the tail; all the enlarged spines on the disc and tail ribbed; mature males with 2 or 3 series of alar spines. Lower surface quite smooth. Dorsal fins close to end of tail, separated by a single (occasionally 2) spine. Brownish, with scattered and rather indistinct darker spots and blotches; in one female specimen (Plate III) there is a pair of yellowish-white blotches immediately in front of the eyes and one on either side in the angle between the pectoral and pelvic fins; lower surface uniformly yellow or white, the tail sometimes stained with greyish.

*Hab.* Argentina; Patagonian-Falklands region.

This species is very closely related to the European *R. radiata*, Donovan,[1] but in that species the tail is longer, the vent being nearer to the tip of the snout than to the end of the tail, the teeth are somewhat smaller and more numerous (38 to 46 rows), and the spines on the disc less well developed. Further, in *R. radiata* the two dorsal fins are usually contiguous or continuous, only occasionally being separated by a spine, and there are generally only two scapular spines.

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[1] *R. scabrata*, Garman, from the east coast of North America, will probably prove to be synonymous with the European form.

**Raja macloviana, sp.n.**

*Raia magellanica* (*non* Steindachner), Regan, 1913, *Trans. R. Soc. Edinb.*, XLIX, p. 231, pl. i.

St. WS 80. 14. iii. 27. 50° 57′ S, 63° 37′ 30″ W. Commercial otter trawl, 152–151 m.: 1 female specimen, 345 mm. (width of disc 220 mm.).

St. WS 95. 17. iv. 27. 48° 58′ 15″ S, 64° 45′ W. Commercial otter trawl, 109–108 m.: 1 female specimen, 205 mm. (width of disc 135 mm.).

St. WS 217. 1. vi. 28. 46° 28′ S, 60° 18′ W. Commercial otter trawl, 146 m.: 2 female specimens, 390, 420 mm. (width of disc 250, 300 mm.).

St. WS 218. 2. vi. 28. 45° 45′ S, 59° 35′ W. Commercial otter trawl, 311–247 m.: 1 male specimen, 350 mm. (width of disc 240 mm.), 1 female, 400 mm. (width of disc 270 mm.).

St. WS 225. 9. vi. 28. 50° 20′ S, 62° 30′ W. Commercial otter trawl, 162–161 m.: 3 male specimens, 270–425 mm. (width of disc 180–285 mm.),[1] 1 female, 280 mm. (width of disc 190 mm.).

St. WS 817. 14. i. 32. 52° 23′ S, 64° 19′ W. Commercial otter trawl, 191–238 m.: 2 male specimens, 230, 330 mm. (width of disc 150, 225 mm.), 1 female, 340 mm. (width of disc 230 mm.).

Disc a little broader than long, its width $\frac{3}{5}$ to $\frac{2}{3}$ of the total length; anterior margins scarcely undulated, not emarginate; outer angles rounded. Vent more or less equidistant from tip of snout and end of tail. Snout not projecting, its length about $\frac{1}{7}$ to more than $\frac{1}{6}$ width of disc; interorbital width equal to or less than longitudinal diameter of eye; length of eye + spiracle $1\frac{2}{5}$ to $1\frac{3}{4}$ in that of snout. Opening of spiracle extending forward below eye. Internasal width more than $\frac{1}{2}$ praeoral length of snout. Teeth of moderate size, with flattened crowns; 26 to 36 rows in upper jaw, which has a shallow median notch. Upper surface of disc more or less covered with small scattered spines, which are more numerous and closer together at its anterior margins and along middle of back; one praeocular and one postocular spine; a pair of scapular spines; a median series of 25 to 29 spines extending from the nuchal region to the first dorsal fin; irregular rows of much smaller spines at edges of tail. Mature males with 2 or 3 irregular series of alar spines. Lower surface quite smooth. Dorsal fins close to end of tail, usually separated by a spine. Brownish, usually with some indistinct scattered round white spots, margined with dark brown or blackish; a pair of larger and more distinct white spots, ringed with dark brown, on posterior parts of pectoral bases; hinder margins of pectorals and edges of pelvics with a white border in the young; lower surface uniformly yellow or white.

*Hab.* Patagonian-Falklands region.

This species appears to be most nearly related to *R. murrayi*, Günther, from Kerguelen, but has a blunter snout, a somewhat shorter and stouter tail, more numerous and smaller teeth, and somewhat different coloration. I have examined the specimen from the Burdwood Bank collected by the 'Scotia', which was identified by Regan as *R. magellanica*. This is now preserved in the Bruce Collection at the Royal Scottish Museum, Edinburgh.

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[1] The largest specimen has been selected as the holotype.

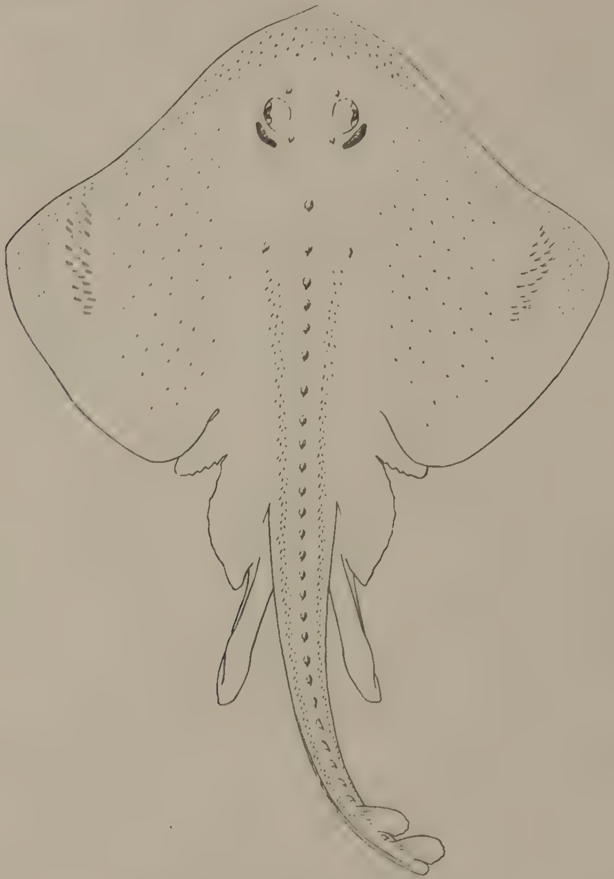

Fig. 5. *Raja macloviana.* Holotype. × 1/3.

**Raja magellanica, Steindachner (Plate IV).**

? *Raia magellanica*, Philippi, 1902, *Revist. Chil.*, VI (1), p. 59.

*Raia magellanica*, Steindachner, 1903, *Zool. Jahrb.*, Suppl. VI, p. 212; Garman, 1913, *Mem. Mus. Comp. Zoöl.*, XXXVI, p. 360; Thompson, 1916, *Proc. U.S. Nat. Mus.*, L, p. 421.

St. WS 72. 5. iii. 27. 51° 07′ S, 57° 34′ W. Commercial otter trawl, 79 m.: 1 male specimen, 190 mm. (width of disc 135 mm.).

St. WS 77. 12. iii. 27. 51° 01′ S, 66° 31′ 30″ W. Commercial otter trawl, 110–113 m.: 1 male specimen, 450 mm. (width of disc 300 mm.), 1 female, 320 mm. (width of disc 225 mm.).

St. WS 78. 13. iii. 27. 51° 01′ S, 68° 04′ 30″ W. Commercial otter trawl, 95–91 m.: 1 female specimen, 375 mm. (width of disc 250 mm.).

St. WS 90. 7. iv. 27. 13 miles N 83° E of Cape Virgins Light, Argentine Republic. Commercial otter trawl, 82–81 m.: 5 female specimens, 140–240 mm. (width of disc 95–160 mm.).

St. WS 91. 8. iv. 27. 52° 53′ 45″ S, 64° 37′ 30″ W. Commercial otter trawl, 191–205 m.: 1 male specimen, 165 mm. (width of disc 105 mm.).

St. WS 92. 8. iv. 27. 51° 58′ 30″ S, 65° 01′ W. Commercial otter trawl, 145–143 m.: 1 male specimen, 185 mm. (width of disc 125 mm.), 1 female, 410 mm. (width of disc 275 mm.).

St. WS 94. 16. iv. 27. 50° 00′ 15″ S, 64° 57′ 45″ W. Commercial otter trawl, 110–126 m.: 3 male specimens, 445–450 mm. (width of disc 300–310 mm.).

St. WS 95. 17. iv. 27. 48° 58′ 15″ S, 64° 45′ W. Commercial otter trawl, 109–108 m.: 1 male specimen, 300 mm. (width of disc 205 mm.), 3 females, 155–490 mm. (width of disc 105–340 mm.).

St. WS 96. 17. iv. 27. 48° 00′ 45″ S, 64° 58′ W. Commercial otter trawl, 96 m.: 1 male specimen, 140 mm. (width of disc 90 mm.).

St. WS 108. 25. iv. 27. 48° 30′ 45″ S, 63° 33′ 45″ W. Commercial otter trawl, 118–120 m.: 1 male specimen, 280 mm. (width of disc 190 mm.), 1 female, 255 mm. (width of disc 170 mm.).

St. WS 109. 26. iv. 27. 50° 18′ 48″ S, 58° 28′ 30″ W. Commercial otter trawl, 145 m.: 1 male specimen, 445 mm. (width of disc 300 mm.).

St. WS 223. 8. vi. 28. 49° 13′ S, 64° 52′ W. Commercial otter trawl, 114 m.: 1 female specimen, 260 mm. (width of disc 175 mm.).

St. WS 245. 18. vii. 28. 52° 36′ S, 63° 40′ W. Commercial otter trawl, 304–290 m.: 1 female specimen, 360 mm. (width of disc 245 mm.).

St. WS 246. 19. vii. 28. 52° 25′ S, 61° 00′ W. Commercial otter trawl, 267–208 m.: 1 male specimen, 365 mm. (width of disc 260 mm.).

Disc a little broader than long, its width $\frac{2}{3}$ to nearly $\frac{3}{4}$ of the total length; anterior margins more or less undulated, not emarginate; outer angles rounded. Vent a little nearer to end of tail than to tip of snout. Snout scarcely projecting, but with a short, obtuse, triangular projection in the young, its length about $\frac{1}{5}$ width of disc; interorbital width a little less than length of eye + spiracle, which is $1\frac{4}{5}$ to $2\frac{1}{4}$ in that of snout. Internasal width about $\frac{1}{2}$ praeoral length of snout. Mouth nearly straight; teeth rather large, with pointed crowns, which may be worn down so that the teeth appear flat; 26 to 30 rows in the upper jaw. Upper surface of disc mainly smooth, but with a broad area on the anterior margin of each pectoral fin covered with small scattered spines; adults often with a small patch of similar spines on the posterior part of the pectoral, or with the anterior group extending posteriorly to the hinder part of the fin; usually a number of spines on the snout and round the eyes; 1 fairly strong praeocular and 1 similar postocular spine; generally 2 scapular spines, but the outer one may be absent; a median series of 26 to 30 stronger spines, extending from the nuchal region to the first dorsal fin; a strip of small asperities on either side of the median series of spines; mature males with 1 or 2 series of alar spines. Lower surface quite smooth. Dorsal fins close to end of tail, generally separated by a spine. Brownish or greyish, with a number of dark, undulating lines, sometimes broken up into spots,[1] many of them enclosing circular or oval areas of paler ground colour; always a large and more distinct oval pale area, margined with dark brown or black and partially divided into two by a dark line, on posterior part of each pectoral base; lower surface uniformly yellow or white.

*Hab.* Patagonian-Falklands region; Straits of Magellan.

The specimens listed above agree closely with Steindachner's original description except in the matter of the scapular spines, which are said to be three in number on each side. The coloration is so characteristic, however, that there can be little doubt as to the identification of these specimens with Steindachner's species rather than those described above as *R. macloviana.*

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[1] This appears to be the case in the specimens taken in deeper water.

**Raja multispinis,** sp.n.

St. WS 851. 11. ii. 32. 51° 39′ 30″ S, 62° 01′ 15″ W. Commercial otter trawl, 221–197 m.: 1 male specimen, 320 mm. (width of disc 220 mm.). Holotype.

Disc broader than long, its width about $\frac{3}{4}$ of the total length; anterior margins scarcely undulated, not emarginate; outer angles very obtusely pointed. Vent nearer to tip of snout than to end of tail. Snout with a very short, obtuse, triangular projection, its length rather more than $\frac{1}{6}$ width of disc; interorbital width rather less than length of eye + spiracle, which is $2\frac{2}{5}$ in that of snout. Internasal width about $\frac{1}{2}$ praeoral length of snout. Mouth nearly straight; teeth rather large, close-set, with flattened crowns; about 24 rows in upper jaw. Upper surface of disc mainly smooth; areas of well-developed, rather widely separated spinules on anterior parts of pectorals, on the snout, round the eyes, and along the middle of the back; no enlarged ocular spines; 2 scapular spines; a median series of 42 spines of moderate size, extending from the nuchal region to the first dorsal fin; 3 or 4 rows of very small spines on each side of the tail. Lower surface quite smooth. Dorsal fins separated from end of tail by a space which is greater than length of base of first dorsal; a spine between the two fins. Greyish brown, with faint traces of paler and darker spots.

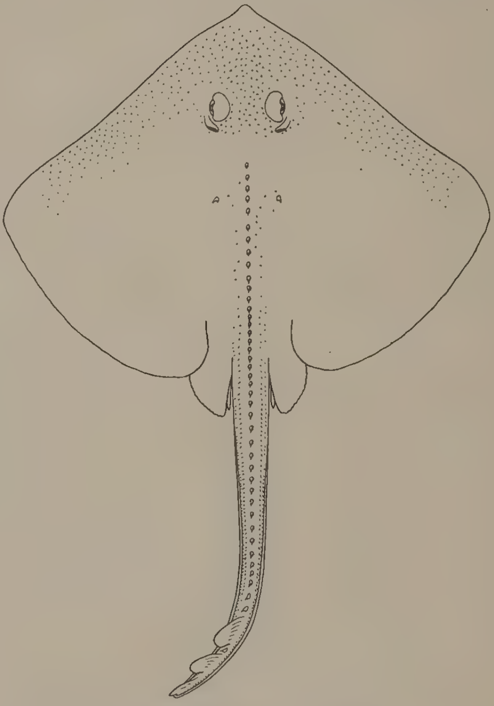

Fig. 6. *Raja multispinis.* Holotype. × $\frac{1}{3}$.

*Hab.* North-west of the Falkland Islands.

**Raja scaphiops,** sp.n.

St. WS 218. 2. vi. 28. 45° 45′ S, 59° 35′ W. Commercial otter trawl, 311–347 m.: 1 female specimen, 410 mm. (width of disc 290 mm.). Holotype.

St. WS 250. 20. vii. 28. 51° 45′ S, 57° 00′ W. Commercial otter trawl, 251–313 m.: 1 female specimen, 350 mm. (width of disc 240 mm.).

St. WS 824. 19. i. 32. 52° 29′ 15″ S, 58° 27′ 15″ W. Commercial otter trawl, 146–147 m.: 1 male specimen, 260 mm. (width of disc 180 mm.).

Disc broader than long, its width about $\frac{2}{3}$ of the total length; anterior margins nearly straight or a little undulated; outer angles obtusely pointed. Vent rather nearer to end

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of tail than to tip of snout. Snout moderately pointed (the margins meeting at an angle of about 90°), its length $\frac{1}{5}$ (young) to more than $\frac{1}{4}$ width of disc; interorbital width equal to or rather less than diameter of eye; length of eye + spiracle $2\frac{2}{3}$ to $3\frac{1}{3}$ in that of snout.

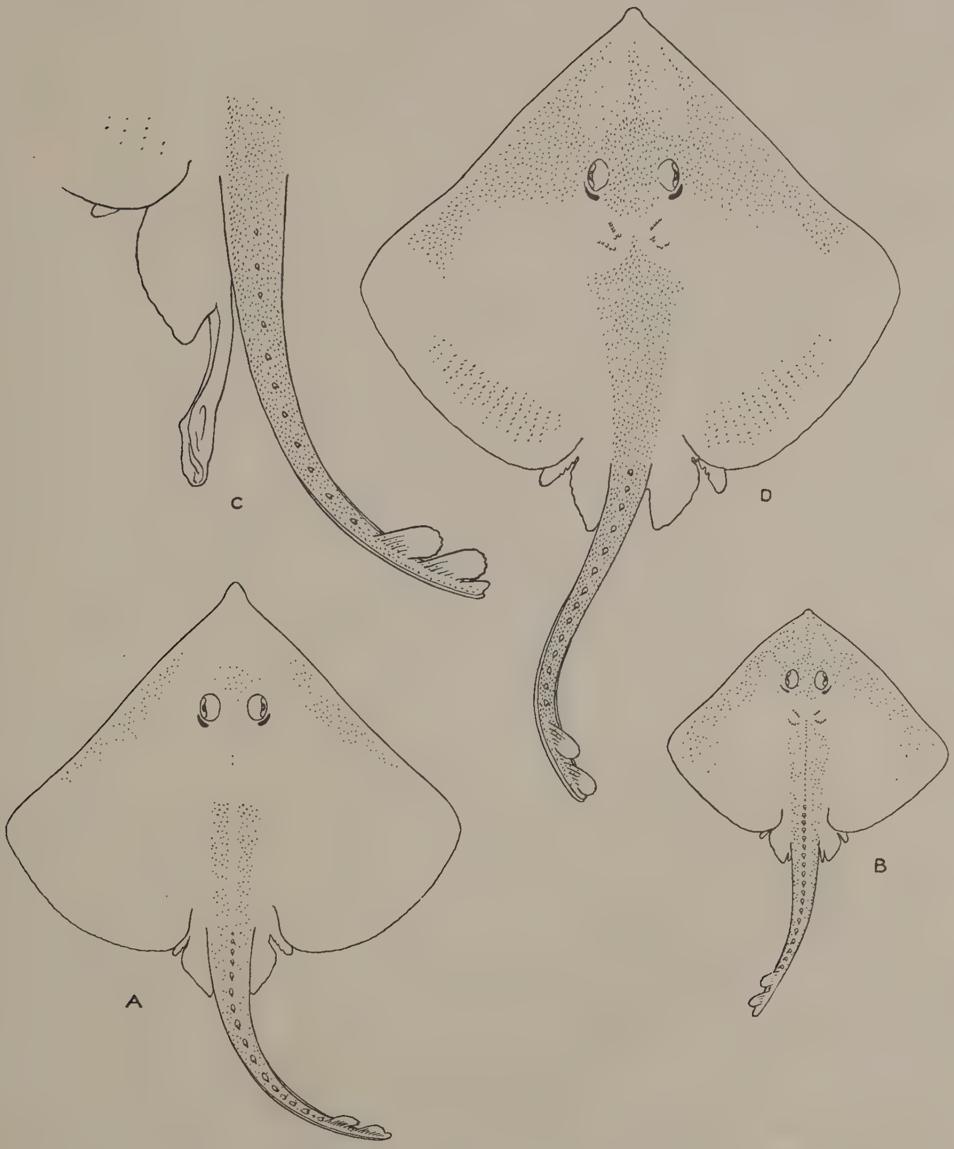

Fig. 7. A, *Raja scaphiops*, holotype; B, *R. scaphiops*, young male; C, *R. eatonii*, tail of mature male; D, *R. eatonii*, female. $\times \frac{1}{4}$.

Internasal width $2\frac{1}{2}$ to $2\frac{3}{4}$ in praeoral length of snout. Mouth nearly straight; teeth of moderate size, with pointed crowns, sometimes worn so that the teeth appear flat; 30 to 34 rows in the upper jaw. Upper surface of disc mainly smooth, but with areas of minute spinules on anterior parts of pectorals, on snout, round the eyes and on the back; no ocular or scapular spines, and no enlarged median spines on the disc; a median series of 17 to 19 sharply pointed, backwardly curved spines on the tail, extending from the pelvic region to the first dorsal fin; in the young male these extend forward on to the disc, but are much smaller in this region and decrease in size anteriorly; edges of tail with minute asperities. Lower surface quite smooth. Dorsal fins close to end of tail, separated by a spine. Brownish, with traces of paler and darker spots or rings; the two females show traces of a pale pectoral ocellus, margined with darker; lower surface uniformly yellow or white, the tail sometimes stained with darker.

*Hab.* North of the Falkland Islands.

This species is close to *R. eatonii*, Günther, from Kerguelen, differing chiefly in the shape of the disc, the narrower interorbital, larger and more numerous median spines on the tail, etc. It is not unlike *R. aguja*, Kendall and Radcliffe, from the coast of Peru, but that species has a shorter snout and smaller and more numerous spines on the tail.

**Raja albomaculata**, sp.n. (Plate V).

St. WS 817. 14. i. 32. 52° 23′ S, 64° 19′ W. Commercial otter trawl, 202–238 m.: 1 male specimen, 400 mm. (width of disc 280 mm.).

St. WS 824. 19. i. 32. 52° 29′ 15″ S, 58° 27′ 15″ W. Commercial otter trawl, 146–137 m.: 1 male specimen, 360 mm. (width of disc 260 mm.).

St. WS 839. 5. ii. 32. 53° 30′ 15″ S, 63° 29′ W. Commercial otter trawl, 403–434 m.: 1 male specimen, 630 mm. (width of disc 420 mm.). Holotype.

St. WS 868. 30. iii. 32. 51° 44′ S, 64° 13′ W. Commercial otter trawl, 166–162 m.: 1 female specimen, 490 mm. (width of disc 330 mm.).

St. WS 875. 3. iv. 32. 52° 36′ S, 63° 47′ 45″ W. Commercial otter trawl, 252–234 m.: 1 male specimen, 370 mm. (width of disc 265 mm.).

The following young specimen may belong here:

St. WS 245. 18. vii. 28. 52° 36′ S, 63° 40′ W. Commercial otter trawl, 304–290 m.: 1 female specimen, 170 mm. (width of disc 105 mm.).

Disc broader than long, its width $\frac{2}{3}$ to more than $\frac{3}{4}$ of the total length; anterior margins a little undulated, not emarginate; outer angles rounded or very obtusely pointed. Vent about equidistant from tip of snout and end of tail. Snout sometimes with a very short obtuse projection, its length about $\frac{1}{6}$ width of disc; interorbital width equal to or a little less than longitudinal diameter of eye; length of eye + spiracle $1\frac{3}{4}$ to twice in that of snout. Internasal width rather more $\frac{1}{2}$ praeoral length of snout. Teeth of moderate size, close-set, with pointed crowns, often worn so that the teeth appear quite flat; 28 to 34 rows in the upper jaw, which has a shallow median emargination. Upper surface of disc mainly smooth, but with patches of minute spinules, chiefly on anterior parts of pectorals, on the snout, round the eyes, and on each side of the median series of spines; in a mature male the disc is nearly smooth, with a few spinules on its anterior edges and in the ocular region; no enlarged ocular or scapular spines; a median series of 17 to 23 strong, curved, compressed spines, extending from the nuchal region to the first dorsal fin, those on the tail stronger than those on disc; 2 or 3 spines on the nuchal region sometimes separated by a gap from the remainder; in a female of 490 mm.

the anterior spines of the series on the disc are wanting; mature males with 3 or 4 series of alar spines. Lower surface quite smooth. Dorsal fins close to end of tail, with or without a spine between them. Brownish or greyish, with a number of small, scattered, rounded white spots, sometimes margined with dark brown; pelvics narrowly edged with white; lower surface uniformly white.

*Hab.* Patagonian-Falklands region.

This species appears to be most nearly related to *R. brachyurops*, but may be at once recognized by the stronger median spines and different coloration, as well as by the form of the mixopterygia.

### Raja brachyurops, Fowler.

*Raia brachyura* (*non* Lafont), Günther, 1880, *Shore Fish. 'Challenger'*, p. 20, pl. vi; Berg, 1895, *Anal. Mus. Nac. B. Aires*, IV, p. 14; Delfin, 1901, *Cat. Peces Chile*, p. 24; Lahille, 1921, *Physis*, V, p. 63.

? *Raia brachyura*, Vaillant, 1888, *Miss. Sci. Cap Horn*, VI. Zool., Poiss., p. 14, pl. ii, figs. 1, 1*b*.

*Raia brachyurops*, Fowler, 1910, *Proc. Acad. N.S. Philad.*, LXII, p. 468; Garman, 1913, *Mem. Mus. Comp. Zoöl.*, XXXVI, p. 360.

? *Raia aguja*, Marini, 1928, *Physis*, IX, p. 274, figs. 1, 2.

? *Raia gallardoi*, Marini, 1933, *Physis*, XI, p. 331.

St. 48. 3. v. 26. 8·3 miles N 53° E of William Point Beacon, Port William, Falkland Islands. Large otter trawl, 105–115 m.: 1 egg-capsule, 1 embryo.

St. 51. 4. v. 26. Off Eddystone Rock, East Falkland Island. Large dredge, 115 m.: 1 male specimen, 130 mm. (width of disc 78 mm.), 1 female, 145 mm. (width of disc 75 mm.). Large otter trawl, 105–115 m.: 3 male specimens, 140–150 mm. (width of disc 85–110 mm.), 3 females, 135–170 mm. (width of disc 85–110 mm.), and 4 very small embryos.

St. WS 73. 6. iii. 27. 51° 01′ S, 58° 54′ W. Commercial otter trawl, 121 m.: 2 male specimens, 240, 400 mm. (width of disc 175, 300 mm.), 2 females, 230, 315 mm. (width of disc 160, 220 mm.).

St. WS 77. 12. iii. 27. 51° 01′ S, 66° 31′ 30″ W. Commercial otter trawl, 110–113 m.: 1 female specimen, 440 mm. (width of disc 320 mm.).

St. WS 78. 13. iii. 27. 51° 01′ S, 68° 02′ W. Commercial otter trawl, 95–91 m.: 1 male specimen, 420 mm. (width of disc 310 mm.), 1 female, 460 mm. (width of disc 330 mm.).

St. WS 79. 13. iii. 27. 51° 01′ 30″ S, 64° 59′ 30″ W. Commercial otter trawl, 132–131 m.: 8 male specimens, 305–550 mm. (width of disc 210–410 mm.), 13 females, 235–530 mm. (width of disc 175–405 mm.).

St. WS 80. 14. iii. 27. 50° 57′ S, 63° 37′ 30″ W. Commercial otter trawl, 152–151 m.: 1 female specimen, 320 mm. (width of disc 230 mm.).

St. WS 87. 3. iv. 27. 54° 07′ 30″ S, 58° 16′ W. Commercial otter trawl, 96–127 m.: 2 male specimens, 215, 240 mm. (width of disc 150, 180 mm.).

St. WS 90. 7. iv. 27. 13 miles N 83° E of Cape Virgins Light, Argentine Republic. Commercial otter trawl, 82–81 m.: 1 male specimen, 240 mm. (width of disc 160 mm.), 1 female, 180 mm. (width of disc 120 mm.).

St. WS 92. 8. iv. 27. 51° 58′ 30″ S, 65° 01′ W. Commercial otter trawl, 145–143 m.: 1 male specimen, 150 mm. (width of disc 105 mm.).

St. WS 94. 16. iv. 27. 50° 00′ 15″ S, 64° 57′ 45″ W. Commercial otter trawl, 110–126 m.: 2 male specimens, 150, 350 mm. (width of disc 98, 250 mm.).

St. WS 95. 17. iv. 27. 48° 58′ 15″ S, 64° 45′ W. Commercial otter trawl, 109–108 m.: 1 female specimen, 140 mm. (width of disc 90 mm.).

St. WS 98. 18. iv. 27. 49° 54′ 15″ S, 60° 35′ 30″ W. Commercial otter trawl, 173–171 m.: 3 male specimens, 250–410 mm. (width of disc 180–310 mm.), 1 female, 440 mm. (width of disc 320 mm.).

St. WS 109. 26. iv. 27. 50° 18′ 48″ S, 58° 28′ 30″ W. Commercial otter trawl, 145 m.: 1 male specimen, 150 mm. (width of disc 100 mm.), 1 female, 140 mm. (width of disc 95 mm.).

St. WS 214. 31. v. 28. 48° 25′ S, 60° 40′ W. Commercial otter trawl, 208–219 m.: 2 female specimens, 300, 490 mm. (width of disc 210, 380 mm.).

St. WS 218. 2. vi. 28. 45° 45′ S, 59° 35′ W. Commercial otter trawl, 311–247 m.: 1 female specimen, 580 mm. (width of disc 430 mm.).

St. WS 225. 9. vi. 28. 50° 20′ S, 62° 30′ W. Commercial otter trawl, 162–161 m.: 2 male specimens, 230, 250 mm. (width of disc 165, 180 mm.), 2 females, 210, 350 mm. (width of disc 140, 265 mm.).

St. WS 233. 5. vii. 28. 49° 25′ S, 59° 45′ W. Commercial otter trawl, 185–175 m.: 1 egg-capsule.

St. WS 234. 5. vii. 28. 48° 52′ S, 60° 25′ W. Commercial otter trawl, 195–207 m.: 1 male specimen, 310 mm. (width of disc 230 mm.), 1 female, 230 mm. (width of disc 170 mm.).

St. WS 239. 15. vii. 28. 51° 10′ S, 62° 10′ W. Commercial otter trawl, 196–193 m.: 3 male specimens, 215–490 mm. (width of disc 145–370 mm.), 1 female, 190 mm. (width of disc 130 mm.).

St. WS 250. 20. vii. 28. 51° 45′ S, 57° 00′ W. Commercial otter trawl, 251–313 m.: 1 male specimen, 400 mm. (width of disc 310 mm.), 1 female, 210 mm. (width of disc 145 mm.).

St. WS 765. 17. x. 31. 45° 07′ S, 60° 28′ 15″ W. Commercial otter trawl, 113–118 m.: 1 male specimen, 480 mm. (width of disc 350 mm.), 2 females, 130, 160 mm. (width of disc 85, 105 mm.), 1 egg-capsule.

St. WS 772. 30. x. 31. 45° 13′ 22″ S, 60° 00′ 15″ W. Commercial otter trawl, 309–162 m.: 1 male specimen, 240 mm. (width of disc 170 mm.), 1 female, 270 mm. (width of disc 200 mm.).

St. WS 783. 5. xii. 31. 50° 08′ S, 59° 50′ W. Commercial otter trawl, 155–159 m.: 2 male specimens, 280, 400 mm. (width of disc 220, 300 mm.), 1 female, 350 mm. (width of disc 240 mm.).

St. WS 784. 5. xii. 31. 49° 47′ 45″ S, 61° 05′ W. Commercial otter trawl, 170–164 m.: 2 male specimens, 180, 195 mm. (width of disc 125, 140 mm.).

St. WS 785. 6. xii. 31. 49° 26′ 30″ S, 62° 34′ W. Commercial otter trawl, 150–147 m.: 1 male specimen, 225 mm. (width of disc 165 mm.).

St. WS 791. 14. xii. 31. 45° 38′ 45″ S, 62° 55′ W. Commercial otter trawl, 96–101 m.: 2 male specimens, 360, 450 mm. (width of disc 290, 330 mm.).

St. WS 800. 21–22. xii. 31. 48° 19′ S, 61° 58′ W. Commercial otter trawl, 137–139 m.: 1 male specimen, 240 mm. (width of disc 170 mm.), 1 female, 225 mm. (width of disc 165 mm.).

St. WS 867. 30. iii. 32. 51° 10′ S, 64° 15′ 30″ W. Small beam trawl, 150–149 m.: 1 female specimen, 670 mm. (width of disc 500 mm.).

St. WS 874. 3. iv. 32. 52° 35′ 30″ S, 65° 14′ W. Commercial otter trawl, 135–132 m.: 2 male specimens, 350, 510 mm. (width of disc 265, 365 mm.).

The following specimens may also belong here:

St. 652. 14. iii. 31. Burdwood Bank (54° 04′ S, 61° 40′ W). Large dredge, 164 m.: 1 egg-capsule, with embryo.

St. WS 799. 21. xii. 31. 48° 04′ 15″ S, 62° 48′ 07″ W. Commercial otter trawl, 137–139 m.: 1 male embryo.

St. WS 850. 11. ii. 32. 51° 18′ 45″ S, 63° 30′ 15″ W. Commercial otter trawl, 157–166 m.: 2 male embryos.

Disc a little broader than long, its width $\frac{2}{3}$ to $\frac{3}{4}$ of the total length; anterior margins more or less undulated, not markedly emarginate; outer angles rounded or obtusely pointed. Vent (in adults) always nearer to end of tail than to tip of snout; in young examples the tail is proportionately longer, the vent being equidistant from snout and

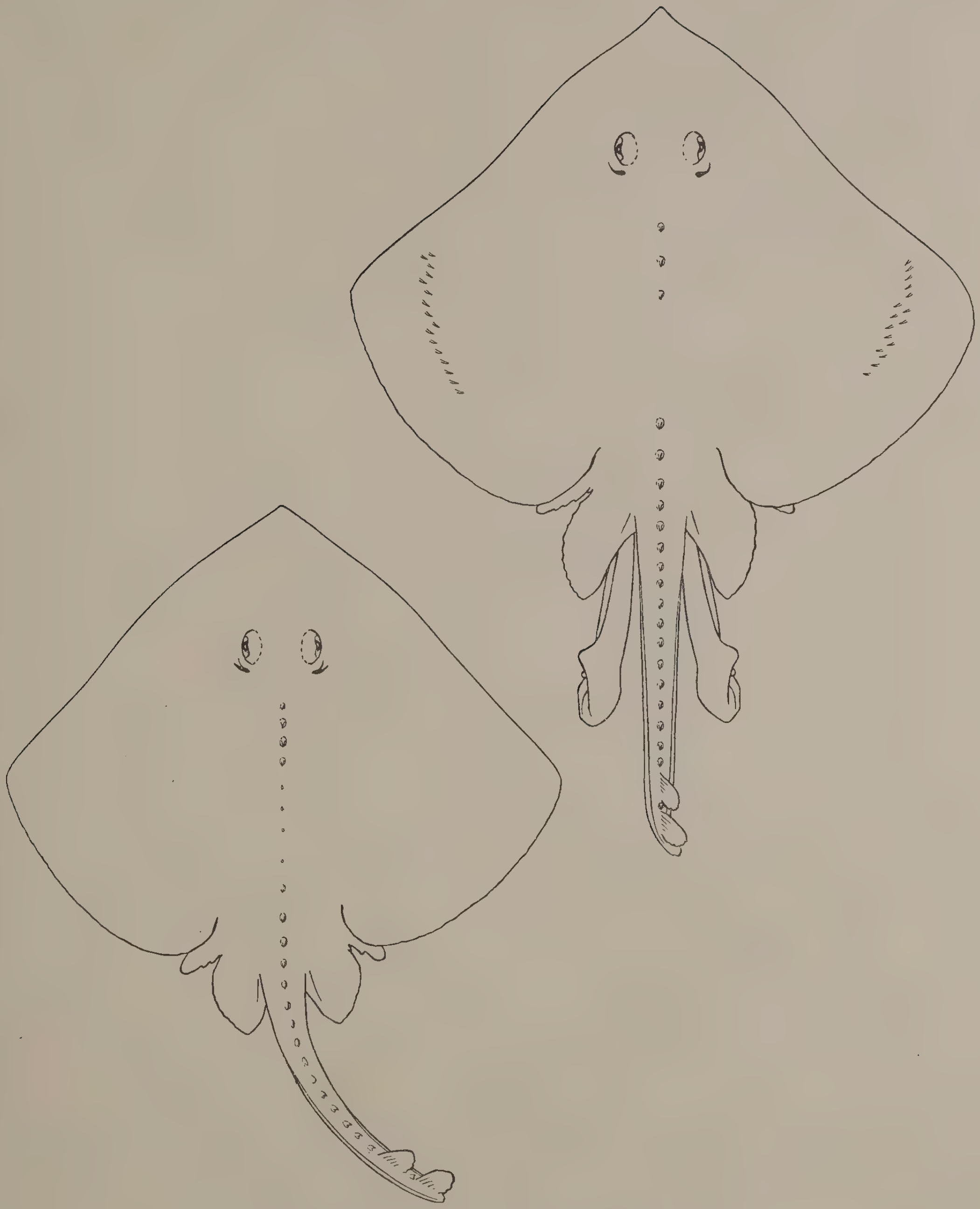

Fig. 8. *Raja brachyurops*. Male (× ⅓), female (× ⅕).

tail or nearer to the former. Snout with a small rounded projection, its length about $\frac{1}{5}$ width of disc; interorbital width equal to or a little greater than longitudinal diameter of eye; length of eye + spiracle $1\frac{3}{4}$ (young) to about 3 in that of snout. Internasal width $1\frac{4}{5}$ to $2\frac{1}{5}$ in praeoral length of snout. Mouth nearly straight; teeth with pointed crowns, often worn so that the teeth appear flat; 22 to 34 rows in the upper jaw. Upper surface of disc with numerous very small spinules, concentrated especially on the anterior parts of the pectoral fins, on the snout, round the eyes, and on the back; in females, and, to a lesser extent in males, there are often numerous spinules on the hinder parts of the pectorals; no ocular or scapular spines; a median series of 12 to 18 strong, sharply pointed, backwardly curved spines, usually extending from opposite the hinder parts of the pectorals to the first dorsal fin; a row of 1 to 5 similar spines on the nuchal and suprascapulary regions, usually separated by a wide gap from the main series, but sometimes extending posteriorly to unite with it; very occasionally these anterior median spines are absent; an area of small spinules, similar to those covering the disc, on each side of the upper surface of the tail; mature males with 2, 3, or more series of alar spines. Lower surface quite smooth. Dorsal fins close to end of tail, generally separated by a spine. Brownish; often with indistinct paler spots of various sizes, some of them margined with dark brown, scattered over the disc; the most conspicuous marking is an ocellus on the hinder part of the base of each pectoral, which may be yellow or white, margined with brown or black, and is sometimes very clear, sometimes faint, and sometimes represented by a faint dark ring; this ocellus may be absent altogether; sometimes a pair of white or yellow spots on the upper surface of the anterior half of the tail, nearly united in the middle line; lower surface of the disc uniformly yellow or white, that of the tail sometimes with irregular dusky spots.

*Hab.* Argentina(?); Patagonian-Falklands region; Straits of Magellan, and west of them.

In addition to the above, I have included the two types collected by the 'Challenger' at Stns. 313 and 314 in the description. One of these is a male, 693 mm. in total length (width of disc 470 mm.), the other a female, 826 mm. long (width of disc 635 mm.).

**Raja griseocauda, sp.n.**

St. WS 218. 2. vi. 28. 45° 45′ S, 59° 35′ W. Commercial otter trawl, 311–247 m.: 1 male specimen, 255 mm. (width of disc 180 mm.).

St. WS 236. 6. vii. 28. 46° 55′ S, 60° 40′ W. Commercial otter trawl, 272–300 m.: 2 male specimens, 320, 322 mm. (width of disc 220, 230 mm.).

St. WS 250. 20. vii. 28. 51° 45′ S, 57° 00′ W. Commercial otter trawl, 313–251 m.: 1 male specimen, 290 mm. (width of disc 200 mm.).

St. WS 817. 14. i. 32. 52° 23′ S, 64° 19′ W. Commercial otter trawl, 202–238 m.: 1 female specimen, 460 mm. (width of disc 330 mm.). Holotype.

St. WS 824. 19. i. 32. 52° 29′ 15″ S, 58° 27′ 15″ W. Commercial otter trawl, 146–137 m.: 1 male specimen, 250 mm. (width of disc 175 mm.).

Closely related to *R. brachyurops*, but with the vent nearly always nearer to tip of snout than to end of tail. Length of snout $\frac{1}{6}$ or rather more than $\frac{1}{6}$ width of disc; length of eye + spiracle $2\frac{1}{3}$ to $2\frac{1}{2}$ in that of snout. Teeth rather smaller; 30 to 36 rows in the upper jaw. Upper surface of disc with numerous small spinules, arranged much as in *R. brachyurops*, but a little larger, less numerous, and placed rather wider apart; no enlarged median spines on disc; median spines on tail somewhat stronger, commencing above origin of pelvic fins. Dorsal fins usually without a spine between them.

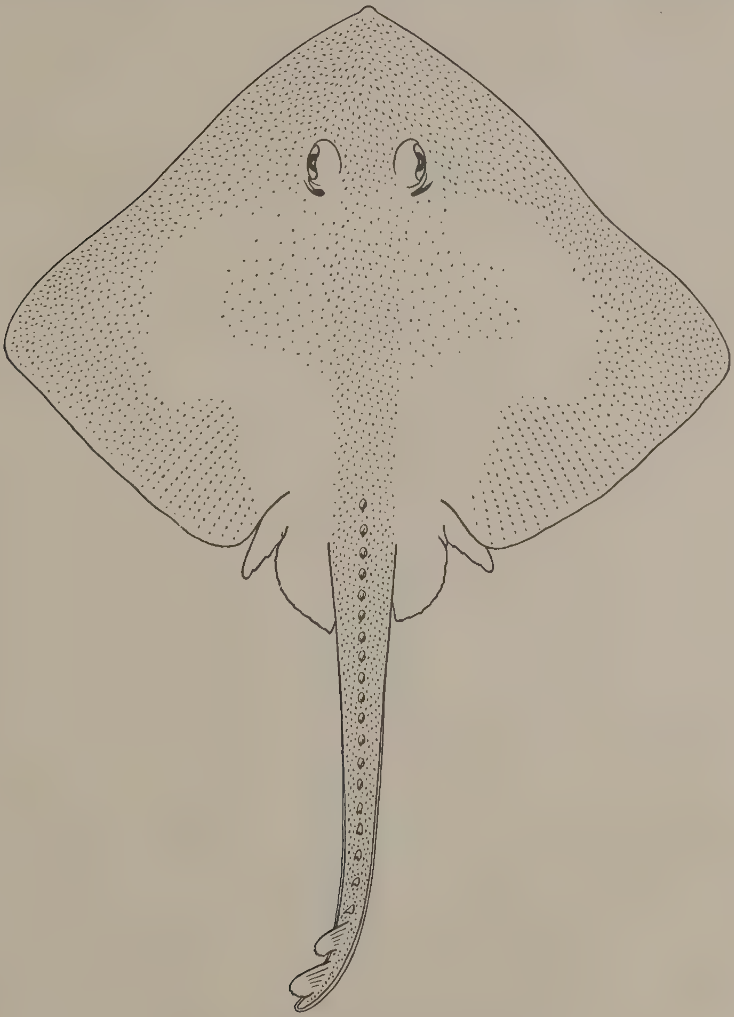

Fig. 9. *Raja griseocauda*. Holotype. × ⅓.

Brownish, with or without traces of darker spots and rings, but apparently without the pectoral ocellus or the pale spots on the tail; lower surface yellow or white; posterior margins of pectorals and pelvics dusky; lateral parts of lower surface of tail, or even the whole of its surface, stained with greyish brown.

*Hab*. Patagonian-Falklands region.

## REVISION OF THE GENUS *PSAMMOBATIS*

### Genus **Psammobatis**, Günther[1]

1870, *Cat. Fish.*, VIII, p. 470. Type *P. rudis*, Günther.
*Malacorhina*, Garman, 1877, *Proc. Boston Soc. N.H.*, XIX, p. 203. Type *Raja mira*, Garman.

This genus is closely related to *Raja*, but lacks the rostral prolongation of the cranium. In the species in which mature males have been described, the anterior margins of the disc are more or less distinctly notched, and the mixopterygia are long, slender, and with their distal ends pointed and not expanded. Another feature is the frequent presence in young and half-grown individuals of both sexes of a very small barbel-like process at the tip of the snout, which may be borne on a small fleshy prominence: this process sometimes persists in the adult.

### *Key to the species*

I. Interorbital width never very much greater than longitudinal diameter of eye; length of eye + spiracle $1\frac{3}{4}$ to about 2 in that of snout, which is $4\frac{4}{5}$ to about 6 in width of disc.
  A. Interorbital width less than longitudinal diameter of eye; a triangular patch of enlarged spines on the scapulary region ... ... ... ... ... ... ... *extenta*.
  B. Interorbital width equal to or rather greater than longitudinal diameter of eye; sometimes 1 to 4 median nuchal spines, but no scapulary spines ... ... ... *scobina*.
II. Interorbital width 2 to 4 times longitudinal diameter of eye; length of eye + spiracle $2\frac{1}{4}$ to nearly 4 in that of snout, which is $4\frac{1}{2}$ to about 7 in width of disc.
  A. Length of snout $4\frac{1}{2}$ to $6\frac{1}{3}$ in width of disc, which is $\frac{2}{3}$ to $\frac{3}{4}$ of the total length of fish.
    1. Length of snout $4\frac{1}{2}$ to $4\frac{3}{4}$ in width of disc, $3\frac{2}{3}$ to nearly 4 times that of eye + spiracle; vent nearer to tip of snout than to end of tail ... ... ... ... ... *microps*.
    2. Length of snout $5\frac{2}{3}$ to $6\frac{1}{3}$ in width of disc, $2\frac{1}{4}$ to $2\frac{1}{2}$ times that of eye + spiracle; vent equidistant from tip of snout and end of tail or nearer to the latter ... ... *lima*.
  B. Length of snout about 7 in width of disc, which is about $\frac{5}{6}$ of the total length of fish ... ... ... ... ... ... ... ... ... ... *brevicaudatus*.

*Raja waitii*, McCulloch, from South Australia, has been associated with this genus by some authors, but has recently been made the type of a new genus, *Irolita*, by Whitley (1931, *Rec. Austral. Mus.*, XVIII, p. 97).

### **Psammobatis extenta** (Garman).

*Raja erinacea* (*non* Mitchill), Ribeiro, 1907, *Arch. Mus. Nac. Rio Janeiro*, XIV, p. 176, pls. xii, xiii.
*Raia extenta*, Garman, 1913, *Mem. Mus. Comp. Zoöl.*, XXXVI, p. 356; Marini, 1928, *Physis*, IX, p. 278, figs.
*Malacorhina cirrifer*, Regan, 1914, *Ann. Mag. Nat. Hist.* (8) XIII, p. 16.
*Psammobatis cirrifer*, Regan, 1914, *Brit. Antarct.* ('*Terra Nova*') *Exped.* 1910, Zool. I (1), p. 21, pl. xiii.
*Raja cirrifera*, Ribeiro, 1923, *Faun. Brasil.*, *Peixes*, II (1), fasc. 1, p. 33.
*Psammobatis bergi*, Marini, 1932, *Physis*, XI, p. 140, 2 figs.

St. WS 788. 13. xii. 31. 45° 05′ S, 65° 00′ W. Commercial otter trawl, 82–88 m.: 1 male specimen, 260 + mm. (width of disc 180 mm.).

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[1] Not to be confused with *Psammobates*, Fitzinger (1835), a genus of reptiles.

Disc broader than long, its width $\frac{1}{2}$ or rather more than $\frac{1}{2}$ of the total length; anterior margins more or less evenly curved in females, notched in males; outer angles rounded. Vent much nearer to tip of snout than to end of tail. Snout with a very small barbel, borne by a small triangular prominence, its length (without barbel) $4\frac{4}{5}$ to $5\frac{1}{2}$ in width of disc; interorbital width less than longitudinal diameter of eye; length of eye + spiracle $1\frac{3}{4}$ to twice in that of snout. Internasal width $2\frac{3}{4}$ to more than 3 times in praeoral length of snout. Mouth with a median emargination in the upper jaw; teeth close-set, with pointed crowns (often worn, so that the teeth appear quite flat); 40 to 44 rows in the upper jaw. Upper surface of disc mainly smooth, but with areas of small, well-separated spines along anterior margins of pectoral fins, and sometimes with a small patch of spines on the hinder part of each pectoral; in the young female the spines are somewhat stronger, mostly with radiating bases, and scattered over the greater part of the disc, being more numerous, however, near the anterior and posterior margins of the pectorals; a series of spines at inner margin of each orbit; a roughly triangular patch on the scapulary region; tail with 3 irregular series of spines posteriorly, and about 5 anteriorly, continued forward on the disc as 2 to 4 irregular rows, which may extend anteriorly as far as the scapulary patch; mature males with 3 or 4 series of alar spines. Lower surface quite smooth. Dorsal fins close to end of tail, separated from one another or contiguous at their bases, separated from or continuous with the caudal fin. Brownish or greyish, spotted or mottled with dark brown and with some small indistinct ocelli scattered over the disc; lower surface uniformly white.

*Hab.* Atlantic coast of South America, from Rio de Janeiro to latitude 45° S.

In addition to the specimen mentioned above, the description is based upon the type of *Psammobatis cirrifer*, a female 220 mm. in total length (width of disc 125 mm.) from Cape Frio, Brazil (22° 56′ S, 41° 34′ W), and 2 specimens, a male 362 mm. (width of disc 210 mm.) and a female 358 mm. (width of disc 200 mm.), from off the coast of Uruguay (34° S, 50° W), presented to the British Museum by Dr T. Marini. The specimen collected by the 'William Scoresby' differs in certain respects (more definitely notched upper jaw, slightly larger eye, different spination and coloration, etc.) from typical examples of *P. extenta*, and it is possible that the southern form represents a distinct species. In view of the extreme variability of *Psammobatis scobina*, however, I am not prepared to give a new name to a single example with mutilated tail.

**Psammobatis scobina** (Philippi).

*Raja scobina*, Philippi, 1857, *Arch. Naturg.*, XXIII (1), p. 270; Philippi, 1892, *An. Mus. Nac. Chile*, I. Zool., p. 2, pl. i, fig. 1; Lönnberg, 1907, *Hamb. Magalh. Sammelr.*, Fische, p. 7.

*Uraptera scobina*, Duméril, 1865, *Hist. Nat. Poiss.*, I, p. 574.

*Psammobatis rudis*, Günther, 1870, *Cat. Fish.*, VIII, p. 470; Günther, 1880, *Shore Fish. 'Challenger'*, p. 20, pl. v; Vaillant, 1888, *Miss. Sci. Cap Horn*, VI. Zool., Poiss., p. 15; Berg, 1895, *Anal. Mus. Nac. B. Aires*, IV, p. 14; Delfin, 1901, *Cat. Peces Chile*, p. 24; Lönnberg, 1907, *t.c.*, p. 7; Thompson, 1916, *Proc. U.S. Nat. Mus.*, L, pp. 404, 421; Lahille, 1928, *Anal. Mus. Nac. B. Aires*, XXXIV, p. 329, fig. 19.

*Raia* (*Malacorhina*) *mira*, Garman, 1877, *Proc. Boston Soc. N.H.*, XIX, p. 207.

*Psammobatis rutrum*, Jordan, 1890, *Proc. U.S. Nat. Mus.*, XIII, p. 334.

*Raja philippii*, Delfin, 1902, *Revist. Chil.*, VI (4), p. 262, pl. x.

*Psammobatis scobina*, Evermann and Kendall, 1906, *Proc. U.S. Nat. Mus.*, XXXI, p. 71; Garman, 1913, *Mem. Mus. Comp. Zoöl.*, XXXVI, p. 370.

*Malacorhina mira*, Garman, 1913, *t.c.*, p. 372, pl. xxvii, figs. 3–5, pl. lxix, figs. 1, 2; Marini, 1928, *Physis*, IX, p. 134, figs.

St. WS 73. 6. iii. 27. 51° 01′ S, 58° 54′ W. Commercial otter trawl, 121 m.: 1 male specimen, 360 mm. (width of disc 240 mm.), 1 female, 370 mm. (width of disc 225 mm.).

St. WS 77. 12. iii. 27. 51° 01′ S, 66° 31′ 30″ W. Commercial otter trawl, 110–113 m.: 1 male specimen, 320 mm. (width of disc 200 mm.), 2 females 350, 385 mm. (width of disc 220, 230 mm.).

St. WS 79. 13. iii. 27. 51° 01′ 30″ S, 64° 59′ 30″ W. Commercial otter trawl, 132–131 m.: 3 male specimens, 350–420 mm. (width of disc 230–255 mm.), 3 females, 340–370 mm. (width of disc 200–230 mm.).

St. WS 80. 14. iii. 27. 50° 57′ S, 63° 37′ 30″ W. Commercial otter trawl, 152–151 m.: 2 male specimens, 305, 360 mm. (width of disc 195, 235 mm.), 1 female, 320 mm. (width of disc 200 mm.).

St. WS 91. 8. iv. 27. 52° 53′ 45″ S, 64° 37′ 30″ W. Commercial otter trawl, 191–205 m.: 1 female specimen, 300 mm. (width of disc 190 mm.).

St. WS 92. 8. iv. 27. 51° 58′ 30″ S, 65° 01′ W. Commercial otter trawl, 145–143 m.: 2 female specimens, 280, 290 mm. (width of disc 170, 180 mm.).

St. WS 94. 16. iv. 27. 50° 00′ 15″ S, 64° 57′ 45″ W. Commercial otter trawl, 110–126 m.: 5 male specimens, 110–325 mm. (width of disc 65–210 mm.), 1 female, 350 mm. (width of disc 220 mm.).

St. WS 95. 17. iv. 27. 48° 58′ 15″ S, 64° 45′ W. Commercial otter trawl, 109–108 m.: 5 male specimens, 225–380 mm. (width of disc 140–240 mm.), 1 female, 185 mm. (width of disc 112 mm.).

St. WS 96. 17. iv. 27. 48° 00′ 45″ S, 64° 58′ W. Commercial otter trawl, 96 m.: 4 male specimens, 112–320 mm. (width of disc 66–200 mm.), 1 female, 325 mm. (width of disc 195 mm.).

St. WS 108. 25. iv. 27. 48° 30′ 45″ S, 63° 33′ 45″ W. Commercial otter trawl, 118–120 m.: 2 male specimens, 350, 400 mm. (width of disc 210, 245 mm.), 1 female, 90 mm. (width of disc 45 mm.).

St. WS 109. 26. iv. 27. 50° 18′ 48″ S, 58° 28′ 30″ W. Commercial otter trawl, 145 m.: 1 female specimen, 320 mm. (width of disc 200 mm.).

St. WS 222. 8. vi. 28. 48° 23′ S, 65° 00′ W. Net (7 mm. mesh) attached to back of trawl, 100–106 m.: 1 male specimen, 82 mm. (width of disc 47 mm.). Commercial otter trawl, 100–106 m.: 1 male specimen, 145 mm. (width of disc 90 mm.).

St. WS 223. 8. vi. 28. 49° 13′ S, 64° 52′ W. Commercial otter trawl, 114 m.: 1 male specimen, 225 mm. (width of disc 130 mm.).

St. WS 229. 1. vii. 28. 50° 35′ S, 57° 20′ W. Commercial otter trawl, 210–271 m.: 1 male specimen, 135 mm. (width of disc 85 mm.).

St. WS 239. 15. vii. 28. 51° 10′ S, 62° 10′ W. Commercial otter trawl, 196–193 m.: 2 male specimens, 285, 305 mm. (width of disc 175, 195 mm.), 1 female, 275 mm. (width of disc 160 mm.).

St. WS 243. 17. vii. 28. 51° 06′ S, 64° 30′ W. Commercial otter trawl, 144–141 m.: 2 females, 88, 130 mm. (width of disc 48, 80 mm.), and 10 egg-capsules.

St. WS 765. 17. x. 31. 45° 07′ S, 60° 28′ 15″ W. Commercial otter trawl, 113–118 m.: 1 male specimen, 360 mm. (width of disc 235 mm.).

St. WS 775. 2. xi. 31. 46° 44′ 45″ S, 63° 33′ W. Commercial otter trawl, 115–110 m.: 1 male specimen, 330 mm. (width of disc 210 mm.).

St. WS 776. 3. xi. 31. 46° 18′ 15″ S, 65° 02′ 15″ W. Commercial otter trawl, 107–99 m.: 1 male specimen, 330 mm. (width of disc 195 mm.), 1 female, 280 mm. (width of disc 175 mm.).

St. WS 782. 4. xii. 31. 50° 29′ 15″ S, 58° 23′ 45″ W. Commercial otter trawl, 141–146 m.: 2 female specimens, 210, 215 mm. (width of disc 125, 130 mm.).

St. WS 787. 7. xii. 31. 48° 44′ S, 65° 24′ 30″ W. Commercial otter trawl, 106–110 m.: 3 male specimens, 360–395 mm. (width of disc 210–245 mm.), 2 females, 325, 335 mm. (width of disc 190, 200 mm.).

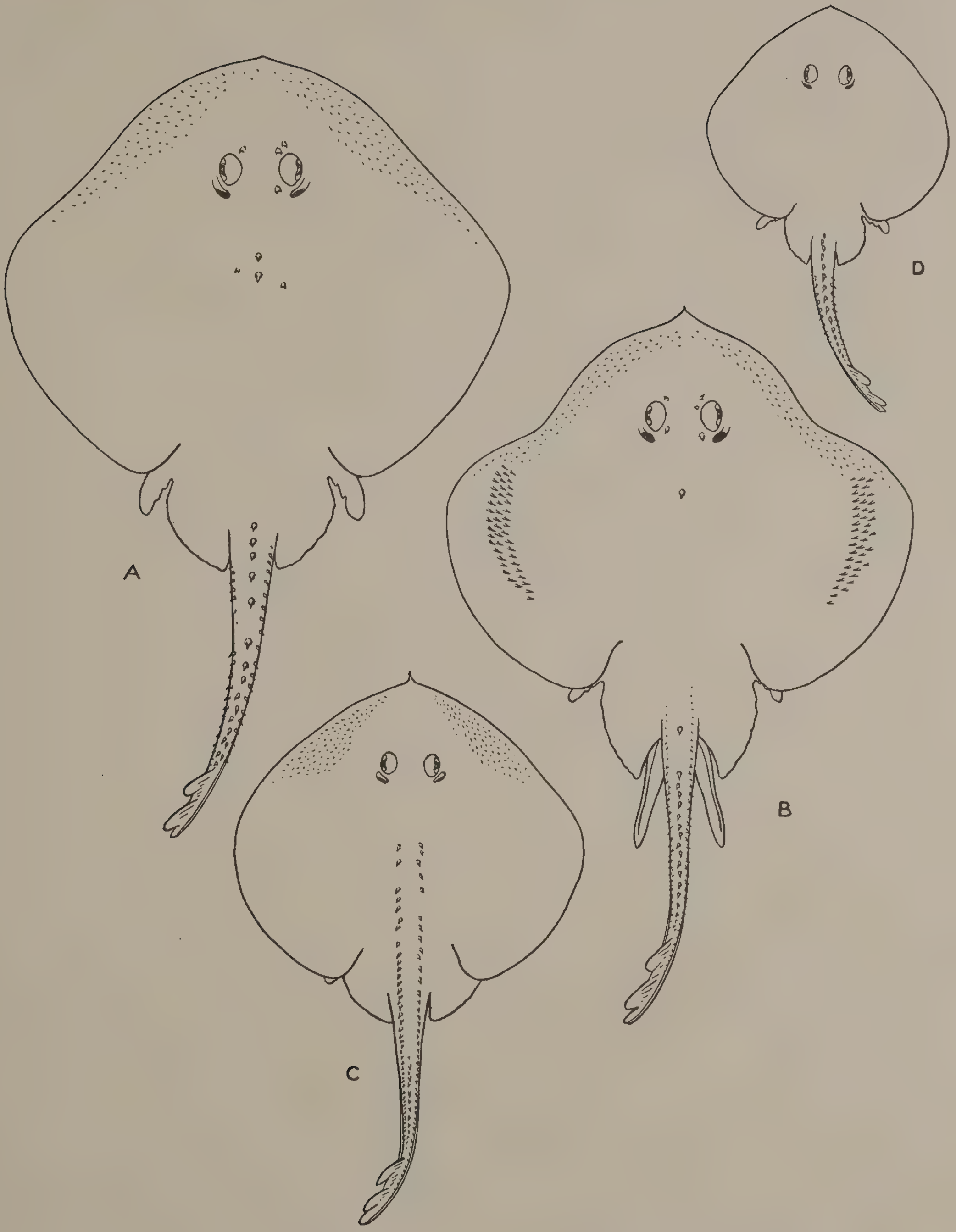

Fig. 10. *Psammobatis scobina.* A, mature female; B, mature male; C, half-grown female; D, young male. ×$\frac{1}{3}$.

St. WS 788. 13. xii. 31. 45° 05′ S, 65° 00′ W. Commercial otter trawl, 82–88 m.: 2 male specimens, 370, 375 mm. (width of disc 230, 235 mm.).

St. WS 797. 20. xii. 31. 47° 47′ 43″ S, 64° 07′ 30″ W. Commercial otter trawl, 111–114 m.: 1 female specimen, 78 mm. (width of disc 43 mm.). Seine net attached to back of trawl, 115–111 m.: 1 male specimen, 85 mm. (width of disc 53 mm.).

St. WS 798. 21. xii. 31. 47° 32′ S, 65° 02′ W. Net (4 mm. mesh) attached to back of trawl, 49–66 m.: 1 male specimen, 76 mm. (width of disc 42 mm.).

St. WS 810. 9. i. 32. 49° 17′ S, 67° 08′ W. Commercial otter trawl, 95–96 m.: 10 male specimens, 155–195 mm. (width of disc 95–125 mm.), 7 females, 170–210 mm. (width of disc 103–125 mm.).

St. WS 817. 14. i. 32. 52° 23′ S, 64° 19′ W. Commercial otter trawl, 202–238 m.: 1 female specimen, 390 mm. (width of disc 255 mm.).

Disc broader than long, its width $\frac{3}{5}$ to a little more than $\frac{2}{3}$ of the total length; nearly circular in young; anterior margins scarcely undulated, not emarginate in females or immature males, notched in mature males; outer angles broadly rounded. Vent nearer to tip of snout than to end of tail. Snout not produced, but often with a small barbel-like process, sometimes borne on a small fleshy projection; this process may be absent altogether, or may persist even in the adult; length of snout $4\frac{4}{5}$ to about 6 in width of disc; interorbital width equal to or rather greater than longitudinal diameter of eye; length of eye + spiracle about twice in that of snout. Internasal width $2\frac{1}{2}$ to nearly 3 in praeoral length of snout. Mouth a little undulated in females and immature males, but with a marked concavity in the upper jaw in mature males; in females and immature males the teeth are nearly flat, in mature males the median teeth have pointed crowns, but laterally the points are directed towards the corners of the mouth, and the extreme lateral teeth are more or less flat; in some specimens the crowns are so much worn that all the teeth appear flat; 28 to 40 rows of teeth in the upper jaw. Upper surface of disc in the young of both sexes covered with minute spinules and rough to the touch; the spinules are most numerous on the anterior parts of the pectoral fins, on the snout, round the eyes, and along the back; there are no enlarged spines on the disc, but an irregular median series of spines of moderate size on the tail, which commences behind the pelvics; upper surface of tail covered with small spinules, which are rather larger than those on the disc. In larger specimens there are generally 1 to 4 median spines on the nuchal region; 1 to 3 praeocular and 1 to 4 postocular spines, the two series sometimes united to form a row of 6 or 7 spines above each orbit; no scapular spines; small spines on anterior parts of pectorals, on snout, round the eyes, and on the back, but the disc is otherwise smooth; tail with 3 rather irregular rows of larger spines, the 2 outer series in some individuals extending anteriorly on to the disc as far as the suprascapulary region. Mature males with 2 to 4 series of alar spines. Lower surface quite smooth. Dorsal fins close together, generally more or less united, separated from or continuous with the caudal fin (when this is present). Brownish or greyish, with or without a number of small scattered dark spots; sometimes, in addition, some small, rounded, white spots of varying size, which may be more or less symmetrically arranged; tail in young often with 2 broad pale cross-bars on its upper surface; lower surface of disc and tail usually uniformly yellow or white.

*Hab.* Coasts of Argentina, Patagonia and Chile.

In addition to the specimens listed above, there are 8 specimens in the British Museum, 90–275 mm. in total length (width of disc 55–180 mm.), from Cape Virgins and the Straits of Magellan, including the type of *Psammobatis rudis.*

I have not examined any material from the coast of Chile, but have little doubt that Philippi's *Raja scobina* represents the species described by Günther as *Psammobatis rudis.* Examination of mature males of this species shows that Garman's *Malacorhina mira* is an undoubted *Psammobatis*, and in all probability represents the same species.

**Psammobatis microps** (Günther).

*Raia microps*, Günther, 1880, *Shore Fish. 'Challenger'*, p. 12, pl. iv; Berg, 1895, *Anal. Mus. Nac. B. Aires*, IV, p. 14; Evermann and Kendall, 1906, *Proc. U.S. Nat. Mus.*, XXXI, p. 70; Garman, 1913, *Mem. Mus. Comp. Zoöl.*, XXXVI, p. 359; Devincenzi, 1920, *Anal. Mus. Montevideo* (II) I (4), p. 127.

? *Raia marplatensis*, Marini, 1935, *Physis*, XI, p. 503, fig.

Disc broader than long, its width about $\frac{3}{5}$ of the total length; anterior margins scarcely undulated; outer angles rounded. Vent a little nearer to tip of snout than to end of tail. In the immature male there is a minute barbel-like process at the tip of the snout. Snout not produced, its length $4\frac{1}{2}$ to $4\frac{3}{4}$ in width of disc; interorbital width 2 or 3 times the longitudinal diameter of the eye, which is about equal to or less than the width of the spiracle; length of eye + spiracle $3\frac{2}{3}$ to nearly 4 in that of snout. Internasal width 2 to $2\frac{1}{4}$ in praeoral length of snout. Mouth a little curved; teeth more or less flat and close-set; about 40 rows in the upper jaw. Upper surface of disc mainly smooth, but with areas of minute spinules on anterior margins of pectoral fins, on the snout, round the eyes, and along the back; in the immature male there is a single median spine in the suprascapulary region, and a series of 11 enlarged sharply pointed spines on the tail, extending from the pelvic region to the first dorsal; in the large female there is a short row of 7 spines on the suprascapulary region and about 17 spines of varying sizes on the tail; in this specimen there are no other enlarged spines on the back, but the minute spinules are arranged in 3 series, the two outer ones being continued on the tail; a single large buckler-like spine near the front margin of each pectoral fin; no ocular spines in the immature male, but in the large female there are 2 above each orbit and 1 close to each spiracle; lower surface smooth or with a narrow rough strip along the anterior margin of each pectoral. Muciferous tubes in the nuchal region very conspicuous, arranged like a fan on each side of the occiput, each opening by a pore. Uniformly brownish above, white below.

*Hab.* Mouth of the Rio Plata.

Described from the type of the species, a male, 390 mm. in total length (width of disc 260 mm.), and a female, 780 mm. long (width of disc 510 mm.). The mature male of this species has not yet been described. *Raia marplatensis* (type a female of 162 mm.) is probably based upon young examples of this species.

**Psammobatis lima (Poeppig).**

*Raja lima*, Poeppig, 1835, *Reise Chili*, I, p. 148; Duméril, 1865, *Hist. Nat. Poiss.*, I, p. 553; Philippi, 1892, *An. Mus. Nac. Chile*, I. Zool., p. 2, pl. i, fig. 3; Delfin, 1901, *Cat. Peces Chile*, p. 23; Garman, 1913, *Mem. Mus. Comp. Zoöl.*, XXXVI, p. 359; Fowler, 1927, *Proc. Acad. N.S. Philad.*, LXXVIII, p. 276.

? *Raia chilensis*, Guichenot, 1848–9, in Gay, *Hist. Chile*, Zool. II, p. 367.

? *Raja acanthostyla*, Philippi, 1896, *An. Univ. Chile*, XCIII, p. 388.[1]

*Raja chilensis*, Steindachner, 1898, *Zool. Jahrb.*, Suppl. IV, p. 332, pl. xxi, fig. 15; Steindachner, 1903, *Zool. Jahrb.*, Suppl. VI, p. 211.

*Raja steindachneri*, Delfin, 1901, *Cat. Peces Chile*, p. 23; Fowler, 1910, *Proc. Acad. N.S. Philad.*, LXII, p. 468; Evermann and Radcliffe, 1917, *Bull. U.S. Nat. Mus.*, XCV, p. 14.

*Raja burgeri*, Delfin, 1902, *Revist. Chil.*, VI (4), p. 267, pl. xii.

Disc broader than long, its width $\frac{2}{3}$ to $\frac{3}{4}$ of the total length; anterior margins scarcely undulated; outer angles rounded. Vent about equidistant from tip of snout and end of tail or nearer to the latter. Snout with a very small blunt projection, but no barbel-like process, its length $5\frac{1}{3}$ to $6\frac{1}{3}$ in width of disc; interorbital width 3 to nearly 4 times the longitudinal diameter of the eye, which is much less than the width of the spiracle; length of eye + spiracle $2\frac{1}{4}$ to $2\frac{1}{2}$ in that of snout. Internasal width about $1\frac{1}{2}$ in praeoral length of snout. Mouth nearly straight or with a shallow emargination in the upper jaw; 40 to 44 rows of teeth in upper jaw. Upper surface of disc mainly smooth, but with areas of minute spinules on anterior margins of pectoral fins, on the snout, round the eyes, and along the back; sometimes a patch of larger spinules on the hinder part of each pectoral; sometimes an irregular median row of enlarged spines from the nuchal region to the first dorsal fin, sometimes 10 or 11 large spines along the tail but none on the disc; sometimes one praeocular and one postocular spine; lower surface with a narrow rough strip along the anterior margin of each pectoral. More or less uniformly greyish or brownish above; lower surface white, the outer parts of the pectoral fins grey.

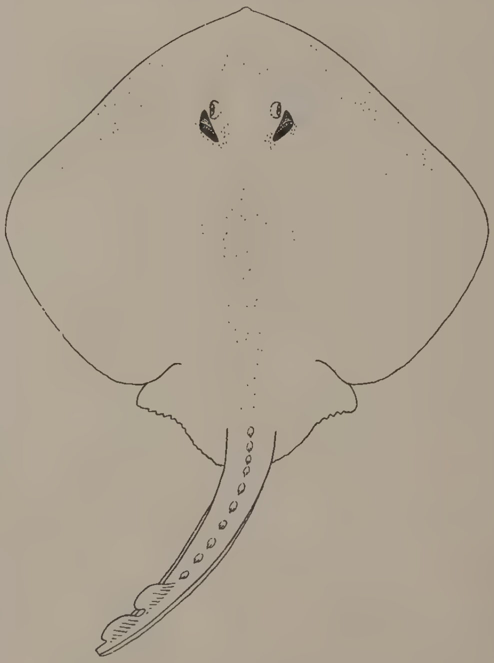

Fig. 11. *Psammobatis lima*. Female. $\times \frac{1}{4}$.

*Hab.* Coasts of Chile and Peru.

Described from 3 specimens, 1 male, 350 mm. long (width of disc 240 mm.) and 2 females, 400 and 450 mm. long (width of disc 300 and 320 mm.) from the Gulf of

[1] The type is a male, 460 mm. long (width of disc 250 mm.).

Arauco (Cavendish Bentinck). I have not seen a mature male of this species, but it seems possible that Philippi's description of *Raja acanthostyla* is based upon such a specimen.

**Psammobatis brevicaudatus**, Cope.

1877, *Proc. Amer. Phil. Soc.*, XVII, p. 48; Fowler, 1910, *Proc. Acad. N.S. Philad.*, LXII, p. 471, fig. 2; Garman, 1913, *Mem. Mus. Comp. Zoöl.*, XXXVI, p. 371.

Disc much broader than long, its width about $\frac{5}{6}$ of the total length; anterior margins notched; outer angles obtusely pointed. "Snout produced like a small papilla between the ends of the pectorals", its length about 7 in width of disc; interorbital width greater than length of eye + spiracle, which is about twice in length of snout. "Top of head and a band along the anterior part of the disc, above and below, rough with minute spines; disc elsewhere smooth, excepting two spines in front of each orbit, a spine near the inner border of each spiracle, a row of a few spines near the edge of the disc opposite the eyes, a median row of 6 or 8 on the middle of the back, a double row parallel to the edge of the pectoral and a median series on the tail." Upper surface "plumbeous with darker shades".

*Hab.* Bay of Pacasmayo, Peru.

Known only from the type, a mature male, 307 mm. long (width of disc 270 mm.), preserved in the Academy of Natural Sciences, Philadelphia.

## CHIMAERIDAE

**Callorhynchus callorhynchus** (Linnaeus).[1]

*Chimaera callorhynchus*, Linnaeus, 1758, *Syst. Nat.*, ed. 10, p. 236.

*Callorhynchus antarcticus*, Schinz, 1822, in Cuvier, *Thierreich*, II, p. 239; Günther, 1870, *Cat. Fish.*, VIII, p. 351.

*Callorhynchus callorhynchus*, Garman, 1904, *Bull. Mus. Comp. Zoöl.*, XLI, p. 271, pl. vii, figs. 7–9, pl. x; Garman, 1911, *Mem. Mus. Comp. Zoöl.*, XL, p. 98.

*Callorhynchus smythii*, (Lay and Bennett) Garman, 1904, *t.c.*, p. 271, pl. vi, figs. 1–4; Garman, 1911, *t.c.*, p. 98.

St. WS 96. 17. iv. 27. 48° 00′ 45″ S, 64° 58′ W. Commercial otter trawl, 96 m.: 1 female specimen, 495 mm.

St. WS 762. 16. x. 31. 43° 50′ S, 65° 01′ 51″ W. Commercial otter trawl, 67–65 m.: 2 male specimens, 320, 620 mm., 4 females, 330–500 mm.

St. WS 763. 16. x. 31. 44° 14′ S, 63° 28′ W. Commercial otter trawl, 87–82 m.: 9 male specimens, 265–315 mm., 2 females, 280, 290 mm.

St. WS 847. 9. ii. 32. 50° 15′ 45″ S, 60° 57′ W. Commercial otter trawl, 51–56 m.: 1 female specimen, 800 mm.

*Hab.* Both coasts of South America, from southern Brazil to Peru.

Garman recognized two species from South America, distinguished by differences in the dentition and in the size of the pectoral fins. In *C. callorhynchus* the tritors of the palatine laminae are said to have the form of elongate parallel bars in the young (as in the young of all species), but in the adult these fuse to form a single tritor with 2 rather broad and thick anterior prongs, of which the outer is the shorter. He gives no measurements of his specimens, nor does he indicate at what size the fusion of the tritors takes place. The pectorals are said to extend beyond the middle of the bases of the pelvics. In the species from Chile and Peru, identified by him as *C. smythii*, the tritors of the palatine laminae are said to persist as separate, elongate, parallel bars, and the pectorals not to reach the pelvics. Among the material collected by the 'Discovery' Expedition, all the smaller specimens (270–330 mm.) exhibit the elongate parallel tritors, and the same condition is found in two larger examples (495 and 800 mm.).[1] In two other specimens (500 and 620 mm.) the tritors have the form described by Garman for *C. callorhynchus*. I find the length of the pectoral fins very variable and quite unreliable as a specific character. There is certainly no correlation between the length of these fins and the form of the dental laminae in the specimens examined by me, and it would appear that the two species *callorhynchus* and *smythii* cannot be maintained on the basis of these characters. It is probable that the examination of an adequate series of specimens would show that the nominal species *capensis*, from South Africa, and *milii*, from Australia, Tasmania, and New Zealand, are nothing more than varieties of *C. callorhynchus*.

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[1] For full synonymy of this species see Garman (1911).

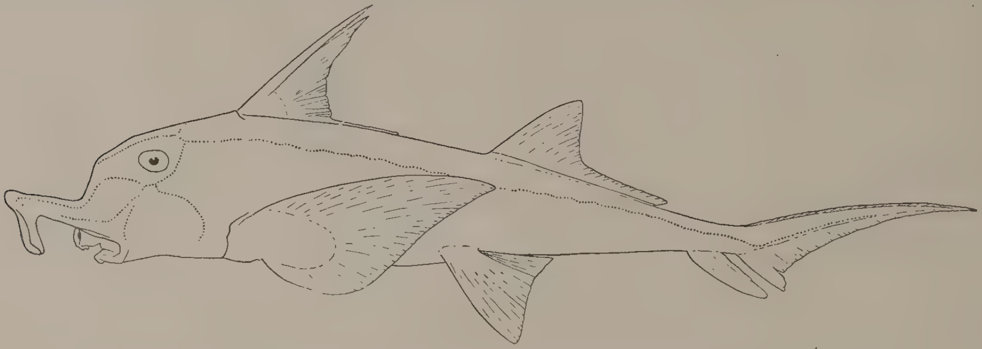

Fig. 12. *Callorhynchus callorhynchus*. Specimen from the coast of Uruguay. × ¼.

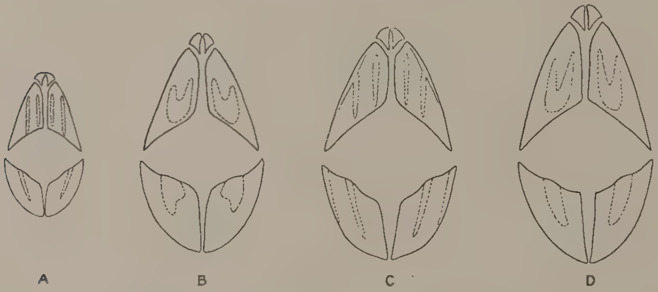

Fig. 13. Dental laminae of *C. callorhynchus*. A, female, 330 mm.; B, female, 495 mm.; C, female, 500 mm.; D, male, 620 mm. × ¾.

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[1] The same condition is to be seen in a specimen of 550 mm. from off the coast of Uruguay (Marini).

# CLUPEIDAE

## *Key to the South American species of* Clupea

I. Pelvic fins 8-rayed; ventral scutes feebly keeled and not sharply pointed.
  A. 38 to 40 gill-rakers on lower part of anterior arch; depth 4 to 5, head 4 to $4\frac{1}{2}$ in length; eye nearly 4 in head ... ... ... ... ... ... ... ... *fuegensis*, Jenyns.
  B. 75 to 95 gill-rakers on lower part of anterior arch; depth $3\frac{1}{2}$ to 4, head $3\frac{1}{3}$ to $3\frac{2}{3}$ in length; eye $4\frac{1}{4}$ to $4\frac{1}{2}$ in head ... ... ... ... ... ... ... *bentincki*, Norman
II. Pelvic fins 7-rayed; ventral scutes strongly keeled and acutely pointed; 25 to 30 gill-rakers on lower part of anterior arch.
  A. Anal 22–23; depth 3 to $3\frac{1}{2}$ in length ... ... ... ... ... *arcuata*, Jenyns.
  B. Anal 17–20; depth $3\frac{1}{3}$ to 4 in length ... ... ... *melanostoma*, Eigenmann.

**Clupea fuegensis, Jenyns.**

1842, *Zool. 'Beagle'*, Fish., p. 133; Günther, 1868, *Cat. Fish.*, VII, p. 413; Smitt, 1898, *Bih. Sv. Vet.-Akad. Handl.*, XXIV, IV, No. 5, p. 59, pl. v, fig. 41; Regan, 1913, *Trans. R. Soc. Edinb.*, XLIX, p. 231; Hussakof, 1914, *Bull. Amer. Mus. Nat. Hist.*, XXXIII, p. 88; Regan, 1916, *Ann. Mag. Nat. Hist.* (8) XVIII, p. 4.

*Clupea arcuata*, Vaillant, 1888, *Miss. Sci. Cap Horn*, VI. Zool., Poiss., p. 16, pl. ii, fig. 2.

2. ii. 27. Stanley Harbour, Falklands. Hand net, surface: 3 specimens, 112–132 mm.

St. WS 86. 3. iv. 27. 53° 53′ 30″ S, 60° 34′ 30″ W. Commercial otter trawl, 151–147 m.: 3 specimens, 168–195 mm.

St. WS 89. 7. iv. 27. 9 miles N 21° E of Arenas Point Light, Tierra del Fuego. Commercial otter trawl, 23–21 m.: 3 specimens, 73–91 mm.

St. WS 214. 31. v. 28. 48° 25′ S, 60° 40′ W. Net (7 mm. mesh) attached to back of trawl, 208–219 m.: 5 specimens, 52–60 mm.

St. WS 220. 3. vi. 28. 47° 56′ S, 62° 38′ W. Net (7 mm. mesh) attached to back of trawl, 108–104 m.: 13 specimens, 50–69 mm.

St. WS 223. 8. vi. 28. 49° 13′ S, 64° 52′ W. Net (7 mm. mesh) attached to back of trawl, 114 m.: 1 specimen, 45 mm.

St. WS 242. 17. vii. 28. 51° 06′ S, 66° 30′ W. Nets (4 and 7 mm. mesh) attached to back of trawl, 119–119 m.: 4 specimens (150–165 mm.).

St. WS 749. 18. ix. 31. 52° 39′ 30″ S, 69° 53′ 30″ W. 1 m. tow-net, 16–0 m.: 25 specimens, 45–55 mm.

St. WS 762. 16. x. 31. 43° 50′ S, 65° 01′ 51″ W. Commercial otter trawl, 67–65 m.: 40 specimens, 100–170 mm.

St. WS 781. 6. xi. 31. 50° 30′ S, 58° 50′ W. Commercial otter trawl, 148 m.: 3 specimens, 180–205 mm.

St. WS 851. 11. ii. 32. 51° 39′ 30″ S, 62° 01′ 15″ W. Commercial otter trawl, 221–197 m.: 15 specimens, 165–195 mm.

Depth of body 4 to 5 in the length, length of head 4 to $4\frac{1}{2}$. Snout as long as or a little longer than eye, diameter of which is nearly 4 in length of head. Maxillary extending nearly or quite to below middle of eye. An elongate patch of minute teeth on tongue; usually a series on palatines; vomer toothless. 38 to 42 gill-rakers on lower part of anterior arch. Praeoperculum narrower than operculum, which is as broad as diameter of eye. About 50 scales in a longitudinal and 14 in a transverse series; ventral scutes feebly keeled and not sharply pointed, 22–25 + 10–13. Dorsal 16–19. Anal

17–20. Pelvics 8-rayed, inserted in or a little behind the vertical from origin of dorsal, rarely a little in advance of it. Vertebrae 49–51.

*Hab.* Patagonian-Falklands region; Straits of Magellan.

In addition to the above, there are a number of specimens from the Falklands in the British Museum, including some collected from the shore by Mr Hamilton and Mr Bennett. The fish is known locally as "Herring" or "Pilchard", and in size and other characteristics is more or less intermediate between the European Herring and Sprat. Mr Bennett notes that its occurrence is very erratic, but he does not know of its capture before 5 October or after April. An occasional shoal is heralded by hundreds and even thousands of shags. Locally there is no means of catching the fish unless they approach close enough to the shore to enable a seine to be used. Hussakof records that the native Indians go out in boats to the kelp, and catch the fishes in their hands, while they are feeding. In February 1904, an extraordinary shoal of these fishes entered Stanley Harbour, and it is recorded that they formed the staple diet of the inhabitants for days.

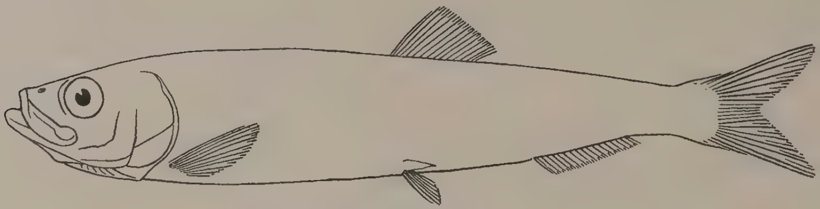

Fig. 14. *Clupea fuegensis.* × $\frac{2}{3}$.

**Clupea bentincki**, Norman.

1936, *Ann. Mag. Nat. Hist.* (10) XVII, p. 491.

*Hab.* Chile.

This is the fish commonly known in Chile as "Sardina", and proves to be distinct from *C. fuegensis.* A fine series of specimens from Talcahuano, where it is said to be very common, has been received from Mr Cavendish Bentinck.

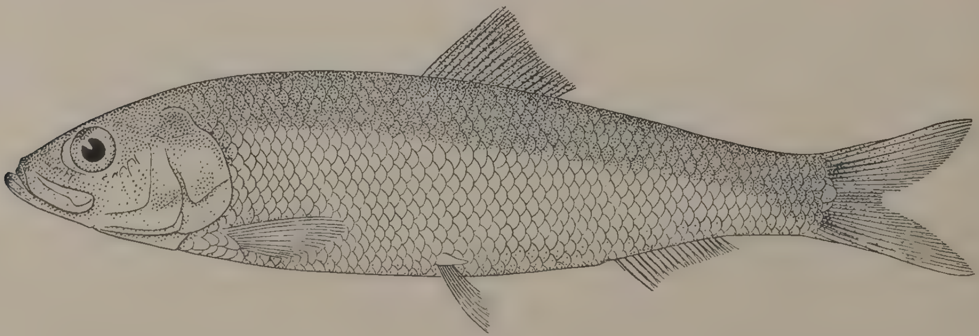

Fig. 15. *Clupea bentincki.* Holotype. × 1.

**Clupea arcuata**, Jenyns.

1842, *Zool. 'Beagle'*, Fish., p. 134; Günther, 1868, *Cat. Fish.*, VII, p. 442; Berg, 1895, *Anal. Mus. Nac. B. Aires*, IV, p. 19; Smitt, 1898, *Bih. Sv. Vet.-Akad. Handl.*, XXIV, IV, No. 5, p. 62, pl. V, fig. 42; Thompson, 1916, *Proc. U.S. Nat. Mus.*, L, p. 405; Regan, 1917, *Ann. Mag. Nat. Hist.* (8) XIX, p. 228.

St. WS 89. 7. iv. 27. 9 miles N 21° E of Arenas Point Light, Tierra del Fuego. Commercial otter trawl, 23–21 m.: 1 specimen, 85 mm. Net (7 mm. mesh) attached to back of trawl, 23–21 m.: 36 specimens, 42–95 mm.

Depth of body 3 to $3\frac{1}{2}$ in the length, length of head 4 to $4\frac{1}{2}$. Diameter of eye 3 to $3\frac{1}{2}$ in length of head. Maxillary extending to below anterior $\frac{1}{3}$ of eye. A narrow strip of teeth on tongue; palate toothless. About 28 gill-rakers on lower part of anterior arch. About 42 scales in a longitudinal and 15 in a transverse series; ventral scutes strongly keeled and acutely pointed, 18–19 + 9–10. Dorsal 16–18, origin nearer to base of caudal than to end of snout. Anal 22–23. Pelvics 7-rayed; inserted below or a little in advance of origin of dorsal. A note on the label states that in life this fish is silvery, but pale lustrous blue dorsally; in younger specimens the yellow muscles appear through the silver; caudal fin yellow, fringed with grey.

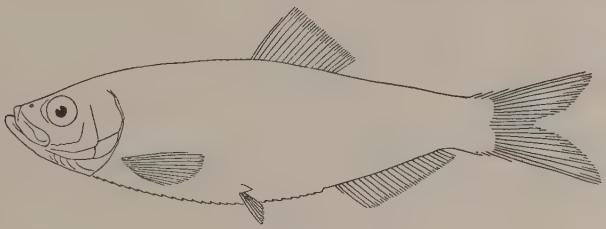

Fig. 16. *Clupea arcuata.* × 1.

*Hab.* Uruguay to Tierra del Fuego.

There are 3 specimens in the British Museum from Montevideo, which have been compared by Regan with the types of the species from Bahia Blanca, preserved in the Zoological Museum, Cambridge. This is a smaller species than *C. fuegensis*, and very similar in appearance to the European Sprat (*C. sprattus*), from which it may be distinguished by the more numerous gill-rakers.

**Clupea melanostoma** (Eigenmann).

? *Sardinella arcuata* (*non* Jenyns), Evermann and Kendall, 1906, *Proc. U.S. Nat. Mus.*, XXXI, p. 74.

*Pomolobus? melanostomus*, Eigenmann, 1907, *Proc. Washington Acad. Sci.*, VIII, p. 452, pl. XXXIII, fig. 6.

*Clupea melanostoma*, Regan, 1917, *Ann. Mag. Nat. Hist.* (8) XIX, p. 229.

Closely related to *C. arcuata*, but with rather more slender body ($3\frac{1}{3}$ to 4) and smaller head ($4\frac{1}{2}$ to 5). Dorsal 15–16; anal 17–20.

*Hab.* Rio Plata.

## GALAXIIDAE

**Galaxias attenatus** (Jenyns).

Regan, 1906, *Proc. Zool. Soc.*, 1905 (2), p. 368, pl. xii, fig. 1, pl. xiii, fig. 2.

*Hab.* South Australia, Victoria, New South Wales; Tasmania; New Zealand and neighbouring islands; Patagonia; Falklands; Tierra del Fuego; Chile.

No specimens were obtained by the expedition, but I have received one (75 mm.) from Mr Bennett, taken by a seine net in Weir Creek, Stanley, Falkland Islands, in November, 1933. This is one of the fishes known locally as "Smelt", and is said to be excellent as food. The maximum size attained is about 6 in.

**Galaxias maculatus** (Jenyns).

Regan, 1906, *t.c.*, p. 370.

*Hab.* Patagonia; Falklands; Tierra del Fuego; southern Chile.

No specimens were obtained by the expedition, but there are several in the British Museum from the Falkland Islands, Alert Bay, Orange Bay, Estero de Penco, and Nige Totten, Chile. In the Falklands, where it is abundant in certain small brooks and streams, this fish is known as "Trout", but the same name appears to be used for *Aplochiton zebra*. The occurrence of *Galaxias maculatus* in the sea has been recorded by Valenciennes and by Philippi off the Falklands and off the coast of Chile respectively.

## APLOCHITONIDAE

**Aplochiton zebra**, Jenyns.

1842, *Zool. 'Beagle'*, Fish., p. 131, pl. xxiv fig. 1.

*Haplochiton zebra*, Günther, 1864, *Cat. Fish.*, v, p. 381; Lönnberg, 1905, *Wiss. Ergebn. Schwed. Südpol.-Exped.*, v (6), p. 22.

No specimens of this species were obtained by the expedition, but Mr Bennett has sent one (about 300 mm.) collected in the Falkland Islands in 1912. This species is known locally as "Trout".

## OPHICHTHYIDAE

**Ophichthus callaensis**, Günther.

1873, *J. Mus. Godeffroy*, IV, p. 92; Evermann and Radcliffe, 1917, *Bull. U.S. Nat. Mus.*, XCV, p. 25.

St. WS 673. 8. vii. 31. 11° 23′ 36″ S, 77° 3′ W. 70 cm. tow-net, 47–0 m.: 5 specimens, 91–137 mm.

*Hab.* Peru.

## SYNGNATHIDAE

**Leptonotus blainvilleanus** (Eydoux and Gervais). "Aguja"; "Haouch appourr'h".

*Syngnathus blainvilleanus*, Eydoux and Gervais, 1837, *Poiss. de la 'Favorite'*, in *Magasin de Zool.*, VII, p. 3, pl. xvii; Günther, 1870, *Cat. Fish.*, VIII, p. 162; Thompson, 1916, *Proc. U.S. Nat. Mus.*, L, p. 423.

*Leptonotus blainvilleanus*, Vaillant, 1888, *Miss. Sci. Cap Horn*, VI. Zool., Poiss., p. 16; Duncker, 1915, *Jahrb. Hamburg. Wiss. Anst.*, XXXII, p. 88.

St. WS 593. 18. v. 31. 35° 36′ S, 72° 44′ W. 1 m. tow-net, 30–0 m.: 1 specimen, 78 mm.

St. WS 762. 16. x. 31. 43° 50′ S, 65° 01′ 51″ W. Commercial otter trawl, with seine net attached, 67 m.: 4 specimens, 86–110 mm.

*Hab.* Both coasts of South America from northern Patagonia to Chile and Peru.

These young specimens appear to belong to this species, which has not been previously recorded from the eastern side of Patagonia. In the young stages it is very difficult to separate from *Syngnathus acicularis*, Jenyns, and some of the records of the latter from the coast of Argentina may refer to *Leptonotus*.

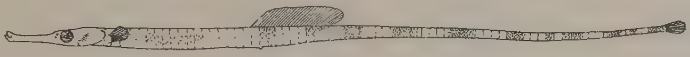

Fig. 17. *Leptonotus blainvilleanus*. Specimen from St. WS 762. × 1.

## MACRURIDAE

**Coryphaenoides holotrachys** (Günther).

*Macrurus holotrachys*, Günther, 1878, *Ann. Mag. Nat. Hist.* (5) II, p. 24; Günther, 1887, *Deep-Sea Fish. 'Challenger'*, p. 136, pl. xxviii, fig. B; Goode and Bean, 1895, *Ocean. Ichth.*, p. 396; Lahille, 1915, *Anal. Mus. Nac. B. Aires*, XXVI, p. 26, pl. vi.

? *Macrurus*, sp. (conf. *holotrachys*), Lönnberg, 1905, *Wiss. Ergebn. Schwed. Südpol.-Exped.*, V (6), p. 9.

*Coryphaenoides holotrachys*, Gilbert and Hubbs, 1916, *Proc. U.S. Nat. Mus.*, LI, p. 144; Devincenzi, 1924, *Anal. Mus. Montevideo* (II) I (5), p. 277.

St. WS 818. 17. i. 32. 52° 31′ 15″ S, 63° 25′ W. Commercial otter trawl, 278–284 m.: 4 specimens, 595–630 mm.

St. WS 819. 17. i. 32. 52° 41′ 52″ S, 62° 39′ 30″ W. Commercial otter trawl, 312–329 m.: 2 specimens, 560, 600 mm.

Snout rather produced (for a *Coryphaenoides*); mouth rather wide, the maxillary extending to below middle of eye or a little beyond; infraorbital ridge fairly prominent. Teeth forming a band in the upper jaw, those of the outer series somewhat enlarged; teeth of the lower jaw in several rows anteriorly, uniserial laterally. Barbel less than $\frac{1}{2}$ diameter of eye, which is greater than length of snout and $2\frac{3}{5}$ to nearly 3 in length of head; interorbital width 5 to $5\frac{1}{3}$. Dorsal II 9; serrations on spine feeble but quite distinct; distance from second dorsal $\frac{1}{4}$ or less than $\frac{1}{4}$ length of head. Origin of anal at distance from head equal to about $\frac{4}{5}$ length of head. Pectoral with 17 to 19 rays; $\frac{1}{2}$ to $\frac{3}{5}$ length of head. Pelvics with 8 rays, outer ray filamentous, extending $\frac{3}{5}$ to $\frac{2}{3}$ of the distance from base of fin to origin of anal. Scales with a strong median spinule-bearing keel, flanked by several short rows of very small spinules, which are more or less parallel with the median keel or converge towards it; some of the scales on the sides of the head with 3 series of spinules converging anteriorly; 5 or 6 scales between dorsal fin and lateral line.

*Hab.* Coasts of Uruguay and Argentina; Patagonian-Falklands region; Straits of Magellan(?).

It is with some hesitation that I have identified the above specimens with *C. holotrachys*, since the type of that species is only 220 mm. in total length and accurate comparison with the large examples is very difficult. The snout seems to be a little longer in the type and the mouth consequently occupies a more ventral position, but this is a character that may well change with growth.

*Coryphaenoides whitsoni* (Regan), from the Antarctic, is closely related, but the scales on the body have only one series of spinules and there are other minor differences. *C. carinatus* (Günther), from Prince Edward Island, has a somewhat smaller eye, smaller scales, and the pectoral fin has 21 rays.

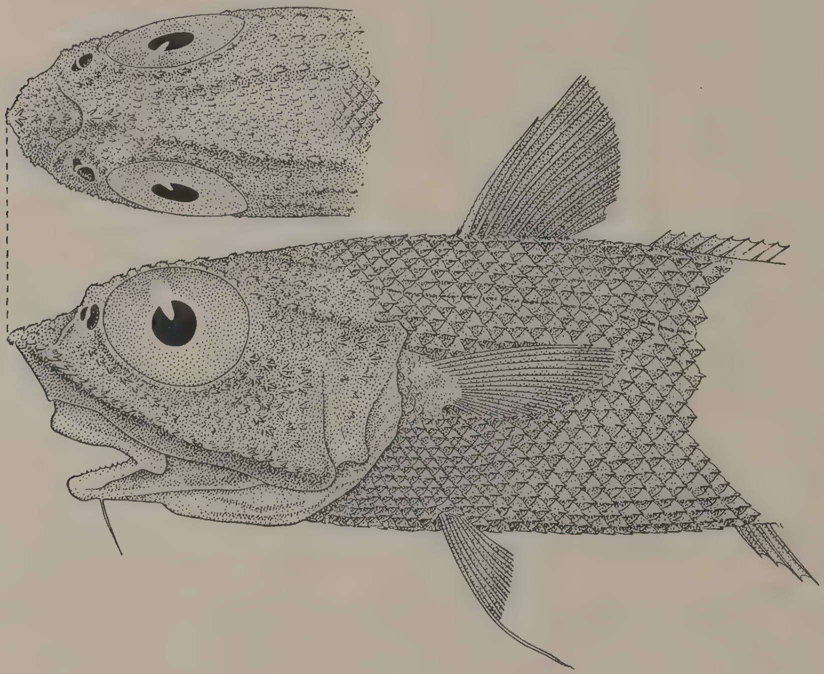

Fig. 18. *Coryphaenoides holotrachys.* × $\frac{1}{2}$.

### **Coelorhynchus fasciatus** (Günther).

*Macrurus fasciatus*, Günther, 1878, *Ann. Mag. Nat. Hist.* (5) II, p. 24; Günther, 1887, *Deep-Sea Fish. 'Challenger'*, p. 129, pl. xxviii, fig. A.

*Coelorhynchus fasciatus*, Goode and Bean, 1895, *Ocean. Ichth.*, p. 402; Gilbert and Thompson, 1916, in Thompson, *Proc. U.S. Nat. Mus.*, L, p. 473.

St. WS 817. 14. i. 32. 52° 23′ S, 64° 19′ W. Commercial otter trawl, 191–238 m.: 9 specimens, 308–340 mm.

St. WS 820. 18. i. 32. 52° 53′ 15″ S, 61° 51′ 30″ W. Net (4 mm. mesh) attached to back of trawl, 351–367 m.: 1 specimen, 185 mm.

St. WS 821. 18. i. 32. 52° 55′ 45″ S, 60° 55′ W. Commercial otter trawl, 461–468 m.: 4 specimens, 290–350 mm.

Snout rather short; the maxillary extending to below middle of eye or a little beyond; infraorbital ridge fairly prominent. Teeth forming bands in both jaws. Barbel $\frac{1}{4}$ to $\frac{1}{3}$ diameter of eye, which is much greater than length of snout and $2\frac{1}{4}$ to $2\frac{2}{5}$ in length of head; interorbital width $4\frac{3}{4}$ to $5\frac{1}{4}$. Dorsal II 9–10; length of spine $\frac{2}{3}$ to $\frac{4}{5}$ of that of head; distance from second dorsal equal to or rather less than length of its base. Origin of anal at distance from head which is much shorter than length of head without snout. Pectoral with 15 to 17 rays; $\frac{3}{5}$ to $\frac{2}{3}$ length of head. Pelvics with 7 rays, outer ray filamentous, about as long as pectoral, extending to beyond origin of anal. Scales with 8 to 18 series of spinules, which are more or less parallel on the body scales, but converge anteriorly on those of the head; 3 or 4 scales between dorsal fin and lateral line. A series of irregular dark cross-bars on the back.

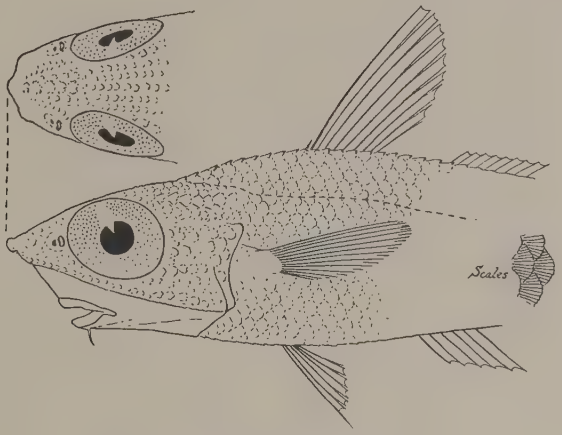

Fig. 19. *Coelorhynchus fasciatus.* × ½.

*Hab.* Patagonian-Falklands region; Straits of Magellan; southern Chile; South Africa.

Three other species of *Coelorhynchus* have been described from this region: *C. marinii*, Hubbs, from Argentina and South Georgia; *C. patagoniae*, Gilbert and Thompson, from the west coast of Patagonia; and *C. chilensis*, Gilbert and Thompson, from off Lota, Chile.

## MERLUCCIIDAE

**Merluccius hubbsi**, Marini. "Yapakama"; "Merluza".

St. WS 73. 6. iii. 27. 51° 01′ S, 58° 54′ W. Commercial otter trawl, 121 m.: 6 specimens, 460–590 mm.

St. WS 78. 13. iii. 27. 51° 01′ S, 68° 04′ 30″ W. Commercial otter trawl, 95–91 m.: 6 specimens, 380–445 mm.

St. WS 80. 14. iii. 27. 50° 57′ S, 63° 37′ 30″ W. Commercial otter trawl, 152–156 m.: 1 specimen, 720 mm.

St. WS 90. 7. iv. 27. 13 miles N 83° E of Cape Virgins Light, Argentine Republic. Commercial otter trawl, 82–81 m.: 1 specimen, 715 mm.

St. WS 95. 17. iv. 27. 48° 58′ 15″ S, 64° 45′ W. Commercial otter trawl, 108–109 m.: 1 specimen, 130 mm.

St. WS 96. 17. iv. 27. 48° 00′ 45″ S, 64° 58′ W. Commercial otter trawl, 96 m.: 6 specimens, 225–280 mm.

St. WS 97. 18. iv. 27. 49° 00′ 30″ S, 61° 58′ W. Commercial otter trawl, 146–145 m.: 1 specimen, 850 mm.

St. WS 108. 25. iv. 27. 48° 30′ 45″ S, 63° 33′ 45″ W. Large otter trawl, 118 m.: 1 specimen, 275 mm.

St. WS 218. 2. vi. 28. 45° 45′ S, 59° 35′ W. Commercial otter trawl, 311–247 m.: 2 specimens, 705, 750 mm.

St. WS 762. 16. x. 31. 43° 50′ S, 65° 01′ 51″ W. Commercial otter trawl, 67–65 m.: 3 specimens, 150–195 mm.

St. WS 763. 16. x. 31. 44° 14′ S, 63° 28′ W. Commercial otter trawl, 87–82 m.: 10 specimens, 100–260 mm.

St. WS 776. 3. xi. 31. 46° 18′ 15″ S, 65° 02′ 15″ W. Net attached to back of trawl, 107–99 m.: 22 specimens, 150–225 mm.

St. WS 788. 13. xii. 31. 45° 05′ S, 65° 00′ W. Commercial otter trawl, 82–88 m.: 25 specimens, 105–280 mm.

St. WS 817. 14. i. 32. 52° 23′ S, 64° 19′ W. Commercial otter trawl, 202–238 m.: 1 specimen, 900 mm.

St. WS 818. 17. i. 32. 52° 31′ 15″ S, 63° 25′ W. Commercial otter trawl, 278–284 m.: 1 specimen, 960 mm.

St. WS 855. 22. iii. 32. 45° 58′ 30″ S, 64° 11′ W. Commercial otter trawl, 115–110 m.: 12 specimens, 137–180 mm.

St. WS 857. 23. iii. 32. 47° 11′ 30″ S, 64° 12′ W. Commercial otter trawl, 122–124 m.: 1 specimen, 150 mm.

No data. 1 specimen, 880 mm.

For synonymy and description see below.

## A Revision of the Species of *Merluccius*

The difficulty of distinguishing the species of this commercially important group of fishes has led me to undertake a revision of the genus.[1] Hake are to be found in both the North Temperate and the South Temperate regions, and, as far as I am able to judge from the material at my disposal, there are 3 species in the north and 4 in the south.

### *Key to the species*

I. 100 to 150 scales in a longitudinal series; eye 4 to $7\frac{2}{3}$ in head (in specimens of 100–960 mm.).
  A. 7 or 8 gill-rakers on lower part of anterior arch; pelvic as long as or nearly as long as pectoral, which is $1\frac{2}{3}$ to $1\frac{4}{5}$ in head ... ... ... ... ... ... ... *merluccius*.
  B. 10 to 18 gill-rakers on lower part of anterior arch; pelvic nearly always shorter than pectoral.
    1. Pectoral not or scarcely reaching vent, $1\frac{3}{5}$ to $1\frac{4}{5}$ in head; 10 to 13 gill-rakers on lower part of anterior arch; about 130 scales in a longitudinal series ... ... *hubbsi*.
    2. Pectoral extending to vent or beyond, $1\frac{1}{4}$ to $1\frac{2}{3}$ in head.
      *a*. Depth of body 7 to $7\frac{2}{3}$ in length; pelvic $2\frac{1}{4}$ to $2\frac{1}{2}$ in head, extending about $\frac{3}{5}$ of distance from its base to vent; 15 to 17 gill-rakers on lower part of anterior arch; 130 to 135 scales in a longitudinal series ... ... ... ... ... *productus*.
      *b*. Depth of body 5 to $6\frac{1}{4}$ in length; pelvic $1\frac{2}{3}$ to $2\frac{1}{4}$ in head, extending $\frac{3}{5}$ to $\frac{5}{6}$ of distance from its base to vent.
        α. 15 to 18 gill-rakers on lower part of anterior arch; pectoral with 15 or 16 rays; 110 to 115 scales in a longitudinal series; first dorsal with 11 rays ... *gayi*.

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[1] A good summary of our knowledge of the genus has been given by Belloc (1929, *Rév. Trav. Pêches Marit.*, II, p. 153).

β. 10 to 14 (15) gill-rakers on lower part of anterior arch; pectoral with 13 or 14 rays.

* 100 to 110 scales in a longitudinal series; first dorsal with 12 or 13 rays; pelvic extending $\frac{3}{5}$ to $\frac{2}{3}$ of distance from its base to vent … … *bilinearis.*

** 130 to 140 scales in a longitudinal series; first dorsal with 10 or 11 rays; pelvic extending $\frac{2}{3}$ to $\frac{5}{6}$ of distance from its base to vent … … *capensis.*

II. 155 to 165 scales in a longitudinal series; eye 6 to $7\frac{1}{2}$ in head (in specimens of 340–350 mm.); 10 gill-rakers on lower part of anterior arch; pectoral extending to vent or beyond … *australis.*

**Merluccius merluccius** (Linnaeus).

*Gadus merluccius*, Linnaeus, 1758, *Syst. Nat.*, ed. 10, p. 254.
*Gadus ruber*, Lacepède, 1803, *Hist. Nat. Poiss.*, v, p. 671.
*Merluccius smiridus*, Rafinesque, 1810, *Car. n. gen.*, p. 25.
*Gadus merlus*, Risso, 1810, *Ichth. Nice*, p. 122.
*Gadus maraldi*, Risso, 1810, *t.c.*, p. 123.
*Onus riali*, Rafinesque, 1810, *Ind. itt. Sicil.*, p. 12.
*Merluccius vulgaris*, Cloquet, 1824, *Dict. Sci. Nat.*, xxx, p. 168; Fleming, 1828, *Brit. Anim.*, p. 195; Günther, 1862, *Cat. Fish.*, iv, p. 344; Carus, 1889–93, *Prodr. Faun. Medit.*, ii, p. 573.
*Gadus merluccius* [*argentatus*], Faber, 1829, *Naturg. Fische Islands*, p. 91.
*Merlucius ambiguus*, Lowe, 1840, *Proc. Zool. Soc.*, p. 37.
*Merlucius sinuatus*, Swainson, 1840, in Lowe, *t.c.*, p. 38.
*Merlucius lanatus*, Gronovius, 1854, *Cat. Fish.*, ed. Gray, p. 130.
*Epicopus gayi*, Günther, 1860, *Cat. Fish.*, ii, p. 248.
*Merluccius argentatus*, Günther, 1862, *Cat. Fish.*, iv, p. 346.
*Merluccius linnaei*, Malm, 1877, *Göteborgs Bohus. Faun.*, p. 489.
*Merluccius merluccius*, Smitt, 1893, *Scand. Fish.*, i, p. 515, pl. xxv, fig. 1; Jordan and Evermann, 1898, *Bull. U.S. Nat. Mus.*, xlvii (3), p. 2530.
*Merlucius merluccius*, Le Danois, 1920, *Notes Mém. Off. Sci. Tech. Pêches Marit.*, ii; Belloc, 1929, *Rév. Trav. Pêches Marit.*, ii, p. 180, figs. [*q.v.* for full synonymy].
*Trachinoides moroccanus*, Borodin, 1934, *Bull. Vanderbilt Mar. Mus.*, i (4), p. 120, pl. ii, figs. 2, 3.

Depth of body $5\frac{1}{2}$ to $6\frac{1}{4}$ in the length, length of head $3\frac{1}{2}$ to $3\frac{2}{3}$. Snout $1\frac{1}{2}$ times to more than twice as long as eye, diameter of which is 5 (young) to 7 in length of head; interorbital width about 4. Maxillary extending to below middle (young) or posterior edge of eye, length rather less than $\frac{1}{2}$ length of head. 7 or 8 gill-rakers on lower part of anterior arch. About 135 to 150 scales in a longitudinal series below lateral line. Dorsal (9) 10–11, 36–40; anal 36–39. Pectoral with (12) 13–14 rays, extending to or nearly to vent, length $1\frac{2}{3}$ to $1\frac{4}{5}$ in that of head. Pelvic extending $\frac{3}{5}$ to $\frac{2}{3}$ of the distance from its base to the vent, length $1\frac{4}{5}$ to about twice in that of head; insertion of pelvic equidistant from origin of anal and tip of lower jaw or a little nearer to the former.

*Hab.* Coasts of Europe from Norway to the Mediterranean; Greenland and Iceland; coasts of northern and north-western Africa; Madeira.

Described from 15 specimens, 120–800 mm. in total length.

**Merluccius hubbsi**, Marini.

*Merluccius gayi* (*non* Guichenot), Perugia, 1891, *Ann. Mus. Civ. stor. nat. Genova* (2) x [xxx], p. 627; Berg, 1895, *Anal. Mus. Nac. B. Aires*, iv, p. 74; Thompson, 1916, *Proc. U.S. Nat. Mus.*, l, p. 417; Devincenzi, 1924, *Anal. Mus. Montevideo*, (ii) i (5), p. 272; Fowler, 1927, *Proc. Acad. N.S. Philad.*, lxxviii, p. 274.

? *Merluccius gayi*, Cunningham, 1871, *Trans. Linn. Soc. London*, XXVII, p. 472; Vaillant, 1888, *Miss. Sci. Cap Horn*, VI. Zool., Poiss., p. 21.
*Merluccius bilinearis*, Ribeiro, 1915, *Arch. Mus. Nac. Rio Janeiro*, XVII, Merlucciidae, p. 2, fig.
*Merluccius hubbsi*, Marini, 1932, *Physis*, XI, p. 322, fig.

Depth of body $5\frac{3}{4}$ to nearly 8 in the length, length of head $3\frac{1}{2}$ to $3\frac{5}{6}$. Snout $1\frac{1}{4}$ times (young) to nearly 3 times (large specimens) as long as eye, diameter of which is 4 (young) to $7\frac{2}{3}$ in length of head; interorbital width about 4. Maxillary extending to below middle or posterior edge of pupil, length about $\frac{1}{2}$ that of head. Teeth fairly strong; irregularly biserial in lower jaw and anteriorly in upper jaw. 10 to 13 gill-rakers on lower part of anterior arch. About 130 scales in a longitudinal series below lateral line, about 10 in a transverse series between base of first ray of first dorsal fin and lateral line. Dorsal (11) 12–13, 36–39; anal 37–41. Pectoral with 12 to 14 rays, not or scarcely extending to vent in adult and half-grown specimens, reaching to vent or a little beyond in young, length $1\frac{3}{5}$ to $1\frac{4}{5}$ in that of head. Pelvic extending about $\frac{1}{2}$ of the distance from its base to the vent in adult and half-grown specimens, to or nearly to the vent in young, length $1\frac{4}{5}$ to $2\frac{1}{3}$ in that of head; insertion of pelvic about equidistant from tip of lower jaw and origin of anal or a little nearer to the latter.

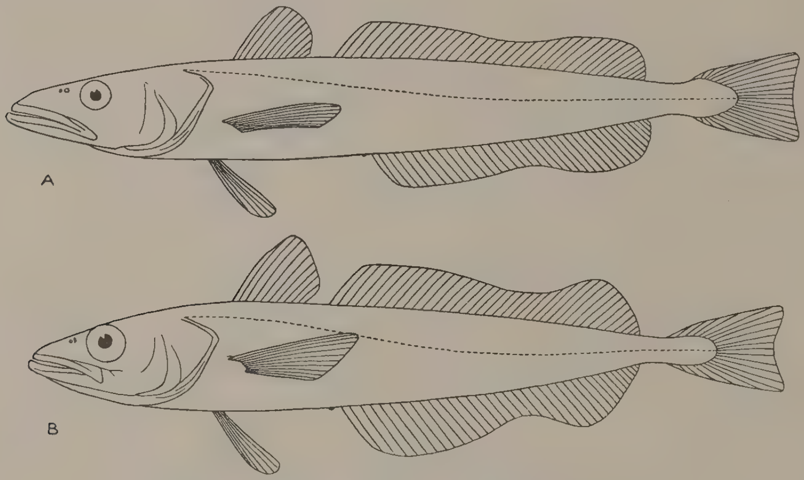

Fig. 20. A, *Merluccius hubbsi*; B, *Merluccius gayi*. × $\frac{1}{4}$.

*Hab.* East Coast of South America, from Brazil to the Straits of Magellan.

Described from numerous specimens, 100–960 mm. in total length.

This species has been confused with *M. gayi*, which may be readily distinguished by the longer pectoral fin, extending to or beyond the origin of the anal, its length $1\frac{1}{3}$ to $1\frac{1}{2}$ in that of head. Further, if specimens of equal size are compared, it will be seen that the eye is a little larger, the maxillary shorter, the teeth smaller, etc. in *M. gayi*.

**Merluccius productus** (Ayres).

*Merlangus productus*, Ayres, 1855, *Proc. Calif. Acad. Nat. Sci.*, p. 64.

*Homalopomus trowbridgii*, Girard, 1856, *Proc. Acad. N.S. Philad.*, p. 132.

*Gadus productus*, Günther, 1862, *Cat. Fish.*, IV, p. 338.

*Merluccius productus*, Gill, 1863, *Proc. Acad. N.S. Philad.*, p. 247; Jordan and Evermann, 1898, *Bull. U.S. Nat. Mus.*, XLVII (3), p. 2531, fig. 884; Starks and Morris, *Univ. Calif. Publ. Zool.*, III (11), p. 241; Belloc, 1929, *Rév. Trav. Pêches Marit.*, II, p. 169, fig. 11.

Depth of body 7 to $7\frac{2}{3}$ in the length, length of head $3\frac{2}{3}$ to $3\frac{5}{6}$. Snout $1\frac{1}{3}$ times to twice as long as eye, diameter of which is $4\frac{3}{4}$ to 6 in length of head; interorbital width about 4. Maxillary extending to below middle of eye, length rather less than $\frac{1}{2}$ that of head. 15 to 17 gill-rakers on lower part of anterior arch. 130 to 135 scales in a longitudinal series below lateral line. Dorsal 11–12, 39–42; anal 41–43. Pectoral with 16 rays, extending to above origin of anal, length $1\frac{1}{4}$ to $1\frac{2}{5}$ in that of head. Pelvic extending about $\frac{3}{5}$ of the distance from its base to the vent, length $2\frac{1}{4}$ to $2\frac{1}{2}$ in that of head; insertion of pelvic very little nearer to origin of anal than to tip of lower jaw.

*Hab.* Pacific coast of America from Puget Sound to Point Loma, California.

Described from 5 specimens, 480–660 mm. in total length.

**Merluccius gayi** (Guichenot).

*Merlus gayi*, Guichenot, 1848–9, in Gay, *Hist. Chile*, Zool. II, p. 329, pl. viii, fig. 2.

*Merluccius gayi*, Kaup, 1858, *Arch. Naturgesch.*, XXIV, p. 87; Günther, 1862, *Cat. Fish.*, IV, p. 346; Delfin, 1901, *Cat. Peces Chile*, p. 100; Delfin, 1903, *Revist. Chil.*, VII, p. 269, fig. 7; Evermann and Radcliffe, 1917, *Bull. U.S. Nat. Mus.*, XCV, p. 156.

? *Merluccius angustimanus*, Garman, 1899, *Mem. Mus. Comp. Zoöl.*, XXIV, p. 183, pl. xli, fig. 1, pl. lxxxii, fig. 1.

Depth of body $5\frac{2}{3}$ to 6 in the length, length of head $3\frac{3}{5}$ to $3\frac{3}{4}$. Snout $1\frac{1}{2}$ times to about twice as long as eye, diameter of which is $4\frac{3}{4}$ to $5\frac{1}{2}$ in length of head; interorbital width about 4. Maxillary extending to below middle of eye, length less than $\frac{1}{2}$ that of head. 15 to 18 gill-rakers on lower part of anterior arch. 110 to 115 scales in a longitudinal series below lateral line. Dorsal 11, 36–40; anal 37–39. Pectoral with 15 or 16 rays, extending to beyond origin of anal, length $1\frac{1}{3}$ to $1\frac{3}{5}$ in that of head. Pelvic extending $\frac{3}{5}$ to $\frac{2}{3}$ of the distance from its base to the vent, length 2 to $2\frac{1}{4}$ in that of head; insertion of pelvic nearer to origin of anal than to tip of lower jaw.

*Hab.* Coasts of Chile and Peru, perhaps extending northwards to the Gulf of Panama.

Described from 4 specimens, 360–485 mm. in total length.

This species is very similar to *M. capensis*, but has a rather smaller head and mouth, rather more gill-rakers, larger scales, and shorter pelvic fins.

**Merluccius bilinearis** (Mitchill).

*Stomodon bilinearis*, Mitchill, 1814, *Rept. Fish. N. York*, p. 7.

*Gadus albidus*, Mitchill, 1818, *J. Acad. N.S. Philad.*, I (14), p. 409.

*Merluccius albidus*, De Kay, 1842, *N.H. New York* (*Fish.*), p. 280.

*Merluccius bilinearis*, Gill, 1863, *Proc. Acad. N.S. Philad.*, p. 247; Goode and Bean, 1895, *Ocean. Ichth.*, p. 386, fig. 330; Jordan and Evermann, 1898, *Bull. U.S. Nat. Mus.*, XLVII (3), p. 2530; Bigelow and Welsh, 1925, *Bull. U.S. Bur. Fish.*, XL (1), p. 386, figs. 194–195; Hildebrand and Schroeder, 1928, *Bull. U.S. Bur. Fish.*, XLIII (1), p. 162, fig. 85; Belloc, 1929, *Rév. Trav. Pêches Mar.*, II, p. 165, fig.

Depth of body 5 to 6 in the length, length of head 3 (young) to nearly 4. Snout 1½ times to about twice as long as eye, diameter of which is 4¾ (young) to 6½ in length of head; interorbital width about 4. Maxillary extending to below hinder part of eye, length about ½ that of head. 10 to 14 (15) gill-rakers on lower part of anterior arch. 100 to 110 scales in a longitudinal series below lateral line. Dorsal 12–13, 36–41; anal 37–40. Pectoral with 13 or 14 rays, extending about to vent, or sometimes a little beyond, length 1⅓ to 1½ in that of head. Pelvic extending ⅗ to ⅔ of the distance from its base to the vent, length 1¾ to nearly twice in that of head; insertion of pelvic equidistant from origin of anal and tip of lower jaw or a little nearer the former.

*Hab.* Coasts of New England and northwards; southwards in deep water to the Bahamas.

Described from 8 specimens, 162–520 mm. in total length.[1]

Readily distinguished from the European species by the greater number of gill-rakers, rather larger scales, higher number of rays in the first dorsal fin, and the longer pectoral fin. It is very close to *M. hubbsi*, but has a longer pectoral fin and there are other minor differences.

### Merluccius capensis, Castelnau.

*Merluccius capensis*, Castelnau, 1861, *Mem. Poiss. Afr. austr.*, p. 68; Regan, 1906, *Ann. Natal Mus.*, I, p. 4; Barnard, 1925, *Ann. S. Afric. Mus.*, XXI, p. 320, pl. xii, fig. 5; Norman, 1935, *Discovery Reports*, XII, p. 48.

Depth of body about 6 in the length, length of head 3⅕ (young) to 3⅗. Snout 1½ times to more than twice as long as eye, diameter of which is 4¼ (young) to 6½ in length of head; interorbital width 3⅗ to nearly 4. Maxillary extending to below posterior edge of pupil or beyond, length less than ½ that of head. 13 or 14 gill-rakers on lower part of anterior arch. 130 to 140 scales in a longitudinal series below lateral line. Dorsal 10–11, 35–40; anal 37–40. Pectoral with about 14 rays, extending to beyond the origin of the anal, length 1⅓ to 1⅔ in that of head. Pelvic extending ⅔ to ⅚ of the distance from its base to the vent, length 1⅔ to 2⅕ in that of head; insertion of pelvic nearer to origin of anal than to tip of lower jaw.

*Hab.* South Africa, from Angola to Natal.

Described from 17 specimens, 160–860 mm. in total length.

### Merluccius australis (Hutton).

*Gadus australis*, Hutton, 1872, *Fish. N. Zealand*, pp. 45, 115, pl. vii, fig. 72.

*Merluccius gayi*, Günther, 1880, *Shore Fish. 'Challenger'*, p. 22; Waite, 1911, *Rec. Canterbury Mus.*, I, p. 182, pl. xxx, fig. 2; Phillipps, 1927, *N.Z. Mar. Dept. Fish. Bull.*, I, p. 23.

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[1] I am greatly indebted to Dr V. Vladykov, of the Biological Board of Canada, for his kindness in obtaining 6 specimens of this species for the British Museum.

Depth of body 5 to 6 in the length, length of head $3\frac{1}{2}$ to $3\frac{3}{4}$. Snout more than twice as long as eye, diameter of which is 6 to $7\frac{1}{2}$ in length of head; interorbital width $3\frac{2}{3}$ to nearly 4. Maxillary extending to below hinder edge of pupil (posterior edge of eye in adults), length about $\frac{1}{2}$ that of head. 10 gill-rakers on lower part of anterior arch. 155 to 165 scales in a longitudinal series below lateral line. Dorsal 11, 36–43; anal 36–42. Pectoral with 13 rays, extending to vent or beyond, length $1\frac{2}{5}$ to $1\frac{2}{3}$ in that of head. Pelvic extending $\frac{3}{5}$ to $\frac{2}{3}$ of the distance from its base to the vent, length $2\frac{1}{6}$ to $2\frac{1}{3}$ in that of head; insertion of pelvic nearer to origin of anal than to tip of lower jaw.

*Hab.* New Zealand; Straits of Magellan.

Described from 3 specimens, 340–435 mm. in total length.

This species is readily distinguished from the other members of the genus by the smaller scales. I am unable to detect any important differences between the specimen collected by the 'Challenger' in the Messier Channel (Magellan) and those from New Zealand.

### Genus **Macruronus**, Günther

*Macruronus*, Günther, 1873, *Zool. Record*, for 1871, p. 103; Günther, 1887, *Deep-Sea Fish. 'Challenger'*, p. 157. Type *Coryphaenoides novae-zelandiae*, Hector.

The firm attachment of the first vertebra to the skull, and the separate frontal bones, with ridges diverging from the occipital crest and bordering a large triangular depression, place this genus in the family Merlucciidae. It differs from *Merluccius* in the tapering tail without caudal fin.

**Macruronus magellanicus**, Lönnberg. "Merluza de cola."

*Macruronus novae-zealandiae* (*non* Hector), Günther, 1880, *Shore Fish. 'Challenger'*, p. 22.
*Macruronus magellanicus*, Lönnberg, 1907, *Hamb. Magalh. Sammelr.*, Fische, p. 15, fig. 2.
*Macruronus argentinae*, Lahille, 1915, *Anal. Mus. Nac. B. Aires*, XXVI, p. 22, pl. v, text-fig. 1.

St. WS 77. 12. iii. 27. 51° 01′ S, 66° 31′ 30″ W. Commercial otter trawl, 110–113 m.: 1 specimen, 450 mm.

St. WS 79. 13. iii. 27. 51° 01′ 30″ S, 64° 59′ 30″ W. Commercial otter trawl, 132–131 m.: 4 specimens, 450–615 mm.

St. WS 91. 8. iv. 27. 52° 53′ 45″ S, 64° 37′ 30″ W. Commercial otter trawl, 191–205 m.: 3 specimens, 430–480 mm.

St. WS 92. 8. iv. 27. 51° 58′ 30″ S, 65° 01′ W. Commercial otter trawl, 145–143 m.: 3 specimens, 530–635 mm.

St. WS 216. 1. vi. 28. 47° 37′ S, 60° 50′ W. Commercial otter trawl, 219–133 m.: 1 specimen, 440 mm.

St. WS 762. 16. x. 31. 43° 50′ S, 65° 01′ 51″ W. Commercial otter trawl with net (7 mm. mesh) attached, 67–65 m.: 18 specimens, 165–230 mm.

St. WS 811. 12. i. 32. 51° 24′ 30″ S, 67° 53′ W. Commercial otter trawl, 96–98 m.: 6 specimens, 680–770 mm.

St. WS 817. 14. i. 32. 52° 23′ S, 64° 19′ W. Commercial otter trawl, 191–202 m.: 5 specimens, 680–840 mm.

St. WS 818. 17. i. 32. 52° 31′ 15″ S, 63° 25′ W. Commercial otter trawl, 272–278 m.: 1 specimen, 910 mm.

St. WS 853. 21. iii. 32. 44° 39′ 45″ S, 64° 13′ 30″ W. Commercial otter trawl, 90 m.: 3 specimens, 198–210 mm.

Length of head $4\frac{3}{4}$ (young) to 6 in the total length. Snout as long as or a little shorter (a little longer in large examples) than eye, diameter of which is $3\frac{1}{5}$ (young) to 4 in length of head; interorbital width about 5. Maxillary extending to below posterior edge of pupil; lower jaw projecting, length about $1\frac{1}{2}$ in that of head; teeth in lower jaw stronger than those in upper, 7 to 9 on each side; vomerine teeth present. Gill-rakers slender, the longest about $\frac{1}{2}$ as long as eye, 22 to 25 on lower part of anterior arch. First dorsal with 12 rays, narrowly separated from the second, which has about 98 rays. Anal with about 95 rays, its origin $1\frac{1}{4}$ to $1\frac{1}{2}$ times as distant from end of tail as from tip of snout. Pectoral with 17 to 19 rays, length $1\frac{1}{2}$ to $1\frac{2}{3}$ in that of head. Pelvic with 8 rays, length $1\frac{4}{5}$ to twice in that of head.

*Hab.* Coasts of Argentina, northwards to Buenos Aires; Patagonian-Falklands region; Straits of Magellan.

This species is very close to *M. novae-zelandiae* (Hector), from New Zealand and Tasmania,[1] but the latter has a distinctly larger eye, which is $3\frac{1}{4}$ (young) to $3\frac{3}{5}$ in length of head. In addition, the interorbital width is $4\frac{2}{3}$ to $4\frac{3}{4}$, the lower jaw $1\frac{3}{5}$ to nearly $1\frac{2}{3}$ in length of head, the maxillary extends to below the middle of the pupil, and the length of the pectoral is $1\frac{1}{3}$ to about $1\frac{1}{2}$ in that of head.

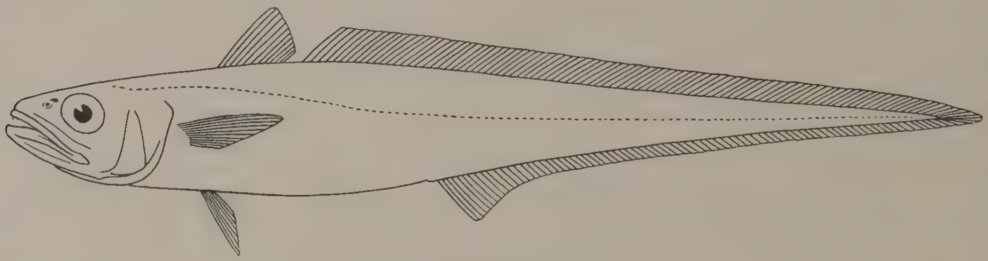

Fig. 21. *Macruronus magellanicus.* × $\frac{1}{3}$.

Mr E. R. Gunther notes that in life this fish is a pale lustrous blue on the sides, becoming more intense on the back where the tones are sapphire and turquoise, and silvery white beneath.

## GADIDAE

### *Key to the genera of southern South America*

I. Three dorsal and two anal fins ... ... ... ... ... ... ... *MICROMESISTIUS*.
II. Two dorsal and one anal fin.
  A. Pelvic fin with flat base and 4 to 9 rays, never much longer than head.
    1. Teeth in villiform bands, those of outer row not enlarged.
      *a.* Vomerine teeth present ... ... ... ... ... ... ... *SALILOTA*.
      *b.* No vomerine teeth ... ... ... ... ... ... ... *PHYSICULUS*.
    2. Teeth in villiform bands, those of the outer row in both jaws enlarged; no vomerine teeth ... ... ... ... ... ... ... ... ... ... *LOTELLA*.

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[1] A good description of this species has been given by Waite (1911, *Rec. Canterbury Mus.*, 1, p. 180, pl. xxx, fig. 1).

B. Pelvic fin reduced to a bifid filament, with or without some other rudimentary rays.

1. First dorsal with 8 to 10 rays; pelvic much longer than head ... *Urophycis.*
2. First dorsal with 5 or 6 rays; pelvic usually shorter than head ... *Laemonema.*

**Micromesistius australis**, sp.n.

St. WS 80. 14. iii. 27. 50° 57′ S, 63° 37′ 30″ W. Commercial otter trawl, 152–151 m.: 4 specimens, 445–510 mm. (holotype, 445 mm.).

St. WS 99. 19. iv. 27. 49° 42′ S, 59° 14′ 30″ W. Commercial otter trawl, 251–255 m.: 5 specimens, 395–440 mm.

St. WS 216. 1. vi. 28. 47° 37′ S, 60° 50′ W. Commercial otter trawl, 219–133 m.: 1 specimen, 165 mm.

St. WS 218. 2. vi. 28. 45° 45′ S, 59° 35′ W. Commercial otter trawl, 311–247 m.: 1 specimen, 435 mm.

St. WS 816. 14. i. 32. 52° 09′ 45″ S, 64° 56′ W. Commercial otter trawl, 150 m.: 1 specimen, 435 mm.

St. WS 817. 14. i. 32. 52° 23′ S, 64° 19′ W. Commercial otter trawl, 191–238 m.: 9 specimens, 273–455 mm.

St. WS 818. 17. i. 32. 52° 31′ 15″ S, 63° 25′ W. Commercial otter trawl, 272–284 m.: 10 specimens, 280–485 mm.

St. WS 824. 19. i. 32. 52° 29′ 15″ S, 58° 27′ 15″ W. Net (7 mm. mesh) attached to back of trawl, 146–137 m.: 1 specimen, 85 mm.

St. WS 850. 11. ii. 32. 51° 18′ 45″ S, 63° 30′ 15″ W. Net (7 mm. mesh) attached to back of trawl, 157–166 m.: 1 specimen, 70 mm.

Related to *Micromesistius poutassou*. Depth of body $6\frac{1}{2}$ to $7\frac{1}{2}$ in the length, length of head 4 (young) to $4\frac{1}{2}$. Snout a little longer than eye, diameter of which is $3\frac{3}{4}$ to 4 in length of head and greater than interorbital width. Maxillary extending to below anterior part of eye, length $2\frac{1}{3}$ to $2\frac{1}{2}$ in that of head; lower jaw more or less strongly projecting; teeth rather more feeble than in *M. poutassou*. 35 to 39 gill-rakers on lower part of anterior arch. Dorsal 11–13, 10–14, 22–26; interval between first and second dorsal a little less than base of former, that between second and third $1\frac{1}{3}$ to $1\frac{2}{3}$ times base of second. Anal 35–38, 21–25. Pectoral with about 20 rays, length $1\frac{1}{3}$ to $1\frac{3}{5}$ in that of head. Pelvics 6-rayed.

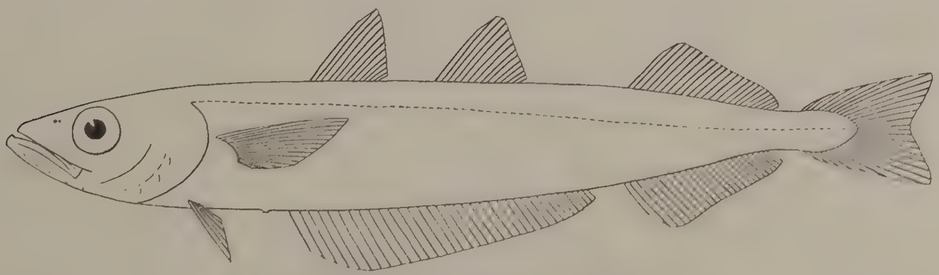

Fig. 22. *Micromesistius australis*. Holotype. × $\frac{1}{3}$.

*Hab.* Patagonian-Falklands region.

This species is very close to *M. poutassou* (Risso), from the Mediterranean and adjacent parts of the Atlantic, but may be at once recognized by the more numerous gill-rakers (35 to 39 instead of about 25). The body is more slender, the eye (usually) rather larger, the teeth feebler, and the pectoral fin apparently longer.

I have followed Gill in regarding *Gadus poutassou* as the type of a genus related to *Pollachius* and *Boreogadus*, and distinguished from them by the dentition, the anterior position of the vent, the long first anal fin and the short second dorsal fin. A glance at the various species is sufficient to show that the old composite genus, *Gadus*, of Günther and other writers cannot be maintained, but a thorough revision of the whole family will be necessary before the limits of the various groups into which it has been subdivided can be ascertained.

### Genus **Salilota**, Günther

1887, *Deep-Sea Fish. 'Challenger'*, p. 95. Type *Haloporphyrus australis*, Günther.

This genus is scarcely separable from *Physiculus*, Kaup, the only important difference being the presence of a patch of vomerine teeth in *Salilota*. It is also closely related to *Lepidion*, Swainson [= *Haloporphyrus*, Günther].

**Salilota australis** (Günther).

*Haloporphyrus australis*, Günther, 1878, *Ann. Mag. Nat. Hist.* (5) II, p. 19.

*Salilota australis*, Günther, 1887, *Deep-Sea Fish. 'Challenger'*, p. 95, pl. xvii, fig. B; Perugia, 1891, *Ann. Mus. Civ. stor. nat. Genova* (2) X [XXX], p. 625; Smitt, 1898, *Bih. Sv. Vet.-Akad. Handl.*, XXIV, IV, No. 5, p. 37; Delfin, 1901, *Cat. Peces Chile*, p. 99; Lönnberg, 1907, *Hamb. Magalh. Sammelr.*, Fische, p. 14; Thompson, 1916, *Proc. U.S. Nat. Mus.*, L, p. 425.

? *Salilota bovei*, Perugia, 1891, *t.c.*, p. 626.

St. 51. 4. v. 26. Off Eddystone Rock, East Falkland Island. From 7 miles N 50° E to 7·6 miles N 63° E of Eddystone Rock. Large otter trawl, 105–115 m.: 3 specimens, 65–78 mm.

St. WS 73. 6. iii. 27. 51° 01′ S, 58° 54′ W. Commercial otter trawl, 121 m.: 3 specimens, 155–380 mm.

St. WS 75. 10. iii. 27. 51° 01′ 30″ S, 60° 31′ W. Commercial otter trawl, 72 m.: 32 specimens, 48–74 mm.

St. WS 78. 13. iii. 27. 51° 01′ S, 68° 04′ 30″ W. Commercial otter trawl, 132–131 m.: 1 specimen, 43 mm.

St. WS 79. 13. iii. 27. 51° 01′ 30″ S, 64° 59′ 30″ W. Commercial otter trawl, 132–131 m.: 7 specimens, 180–348 mm.

St. WS 80. 14. iii. 27. 50° 57′ S, 63° 37′ 30″ W. Commercial otter trawl, 152–151 m.: 13 specimens, 150–435 mm.

St. WS 84. 24. iii. 27. 7½ miles S 9° W of Sea Lion Island, East Falkland Island. Commercial otter trawl, 75–74 m.: 5 specimens, 54–70 mm.

St. WS 89. 7. iv. 27. 9 miles N 21° E of Arenas Point Light, Tierra del Fuego. Commercial otter trawl, 23–21 m.: 2 specimens, 37, 78 mm.

St. WS 214. 31. v. 28. 48° 25′ S, 60° 40′ W. Net (7 mm. mesh) attached to back of trawl, 208–219 m.: 3 specimens, 90–188 mm.

St. WS 219. 3. vi. 28. 47° 06′ S, 62° 12′ W. Net (7 mm. mesh) attached to back of trawl, 116–114 m.: 2 specimens, 65, 85 mm.

St. WS 222. 8. vi. 28. 48° 23′ S, 65° 00′ W. Nets attached to back of trawl, 100–106 m.: 2 specimens, 72, 87 mm.

St. WS 234. 5. vii. 28. 48° 52′ S, 60° 25′ W. Net (7 mm. mesh) attached to back of trawl, 195–207 m.: 1 specimen, 165 mm.

St. WS 244. 18. vii. 28. 52° 00′ S, 62° 40′ W. Commercial otter trawl, 253–247 m.: 1 specimen, 220 mm.

St. WS 586. 8. v. 31. 48° 27′ 30″ S, 74° 23′ 30″ W. Hand line, 22 m.: 1 specimen, 225 mm.

St. WS 764. 17. x. 31. 44° 38′ 15″ S, 61° 58′ 30″ W. Commercial otter trawl, 110–104 m.: 2 specimens, 124, 126 mm.

St. WS 817. 14. i. 32. 52° 23′ S, 64° 19′ W. Commercial otter trawl, 191–202 m.: 2 specimens, 610, 625 mm.

Depth of body 4 to 5 in the length, length of head $3\frac{4}{5}$ to $4\frac{1}{3}$. Snout about as long as eye (shorter in young and a little longer in large specimens), diameter of which is 3 (young) to 5 in length of head and 1 to $1\frac{1}{4}$ in the interorbital width. Maxillary extending to below middle or posterior part of eye; lower jaw shorter than upper; barbel $\frac{1}{2}$ to $\frac{3}{4}$ diameter of eye. 15 to 16 gill-rakers on lower part of anterior arch. 15 to 19 rows of scales from first dorsal fin to lateral line. A circular, unscaled, pigmented area between the bases of the pelvic fins.[1] Dorsal 9–11, 50–57; anal 50–57. Pectoral with 23–25 rays, length $1\frac{1}{2}$ to $1\frac{3}{4}$ in that of head. Pelvics 7- or 8-rayed.

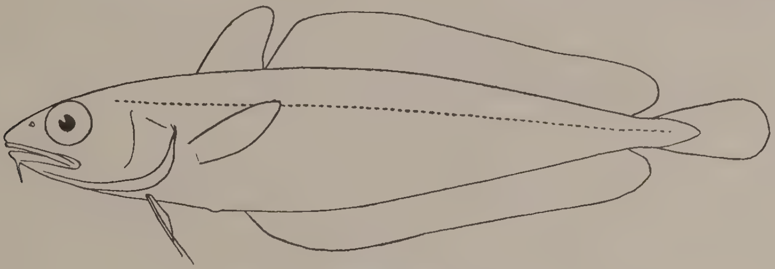

Fig. 23. *Salilota australis*. × ½.

*Hab.* Patagonian-Falklands region; Straits of Magellan; southern Chile.

In addition to the above, there are 6 specimens (145–470 mm.) in the British Museum collection, including the types of the species and one of the types of *S. bovei*.

The specimens described above present some variation in the shape of the head, length of the pelvic fins, size of the mouth, coloration, etc., but I am unable to recognize more than one species.

**Physiculus marginatus** (Günther).

*Lotella marginata*, Günther, 1878, *Ann. Mag. Nat. Hist.* (5) II, p. 19; Günther, 1887, *Deep-Sea Fish. 'Challenger'*, p. 86, pl. xiv, fig. A; Thompson, 1916, *Proc. U.S. Nat. Mus.*, L, p. 425.

St. WS 75. 10. iii. 27. 51° 01′ 30″ S, 60° 31′ W. Commercial otter trawl, 72 m.: 18 specimens, 50–73 mm.

St. WS 817. 14. i. 32. 52° 23′ S, 64° 19′ W. Commercial otter trawl, 202–238 m.: 1 specimen, 180 mm.

St. WS 820. 18. i. 32. 52° 53′ 15″ S, 61° 51′ 30″ W. Net (7 mm. mesh) attached to back of trawl, 351–367 m.: 1 specimen, 160 mm.

St. WS 821. 18. i. 32. 52° 55′ 45″ S, 60° 55′ W. Net (7 mm. mesh) attached to back of trawl, 461–468 m.: 2 specimens, 163, 170 mm.

[1] This is associated with a luminous gland. See Hickling, 1925, *J. Mar. Biol. Ass.*, XIII, p. 914, 4 pls. 7 text-figs.; 1926, *ibid.*, XIV, p. 495, 2 text-figs.; 1931, *ibid.*, XVII, p. 853, 4 pls. 4 text-figures.

Depth of body 5 to $5\frac{2}{3}$ in the length, length of head 4 to $4\frac{1}{2}$. Snout shorter than eye, diameter of which is $2\frac{1}{2}$ to $2\frac{3}{4}$ in length of head and about twice interorbital width. Maxillary extending to below middle of eye; lower jaw a little shorter than upper; barbel $\frac{1}{3}$ to nearly $\frac{1}{2}$ diameter of eye; teeth in villiform bands, those of the outer series scarcely larger than the remainder. 15 to 18 gill-rakers on lower part of anterior arch. Dorsal 7–8, 60–66; anal 56–63. Pectoral with 24 or 25 rays, length about $1\frac{1}{2}$ in that of head. Pelvics 5-rayed; longest ray nearly as long as head. Median fins with dark margins.

*Hab.* Patagonian-Falklands region; Straits of Magellan; southern Chile.

In addition to the above, there are 4 specimens (130–225 mm.) in the British Museum collection, including the types of the species.

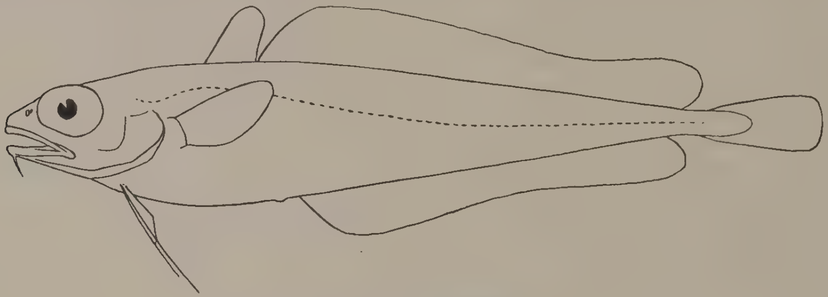

Fig. 24. *Physiculus marginatus.* × $\frac{3}{4}$.

## A SYNOPSIS OF THE SPECIES OF *PHYSICULUS*

I have been led to examine all the specimens of this genus in the British Museum collection, but, as several species are not represented, it has proved impossible to draw up a satisfactory key for their identification.

### *Provisional key to the species*

I. Barbel present.
  A. Second dorsal with 42 to 48 rays; anal with 40 to 53 rays; body stout, the depth $3\frac{2}{3}$ to $4\frac{1}{3}$ in the length ... ... ... ... ... ... ... ... *bachus, barbatus.*
  B. Second dorsal with 49 to 73 rays; anal with 54 to 74 rays; body usually more slender, the depth $4\frac{1}{4}$ to 6 in the length.
    1. 15 to 20 gill-rakers on lower part of anterior arch.
      *a.* Eye $2\frac{1}{2}$ to $2\frac{3}{4}$ in head; about 13 scales in an oblique series from first dorsal to lateral line; median fins with dark margins ... ... ... ... ... *marginatus.*
      *b.* Eye $3\frac{1}{4}$ in head; about 7 scales in an oblique series from first dorsal to lateral line ... ... ... ... ... ... ... ... ... ... *rastrelliger.*
    2. 7 to 14 gill-rakers (including rudiments) on lower part of anterior arch.
      *a.* Eye 3 in head, which is $4\frac{1}{4}$ to $4\frac{3}{4}$ in length of body; maxillary to below posterior margin of pupil... ... ... ... ... ... ... ... ... *capensis.*
      *b.* Eye $3\frac{1}{2}$ to 5 in head, which is $3\frac{1}{2}$ to $4\frac{1}{2}$ in length of body.
        (i) Maxillary to below posterior part of eye or beyond.
          α. Eye $3\frac{1}{2}$ in head; pelvics much shorter than head ... ... ... *fulvus.*
          β. Eye $3\frac{2}{3}$ to $3\frac{3}{4}$ in head; pelvics longer than head ... ... ... *nematopus.*
          γ. Eye $4\frac{1}{2}$ to 5 in head; pelvics a little shorter than head *argyropastus, nigrescens, grinnelli.*

(ii) Maxillary not or scarcely extending to beyond middle of eye.
  α. Pelvics shorter than head.
    * Second dorsal with 57 rays; anal with 55 rays; first ray of dorsal prolonged; pectoral about $1\frac{4}{5}$ in head ... ... ... ... *roseus.*
    ** Second dorsal with 60 to 72 rays; anal with 60 to 74 rays; first ray of dorsal not prolonged; pectoral $1\frac{2}{5}$ to $1\frac{3}{4}$ in head.
      † Pelvics 5- to 7-rayed, length $1\frac{3}{5}$ to 2 in head, which is $3\frac{1}{2}$ to $4\frac{1}{5}$ in length of body.
        ‡ Eye $3\frac{2}{3}$ to 4 in head; first dorsal with 7 rays; pelvics 5-rayed *dalwigkii.*
        ‡‡ Eye $4\frac{1}{4}$ to 5 in head; first dorsal with 9 or 10 rays; pelvics 7-rayed ... ... ... ... ... ... *kaupi, japonicus.*
      †† Pelvics 3- (or 4-) rayed, length about $1\frac{1}{5}$ in head, which is about $4\frac{1}{2}$ in length of body ... ... ... ... ... *peregrinus.*
  β. Pelvics longer than head ... ... ... ... ... ... *longifilis.*
II. No barbel; second dorsal with 64 rays ... ... ... ... ... ... ... *edelmanni.*

*Physiculus natalensis*, Gilchrist (1922, *Fish. Mar. Surv. S. Afr.* II, 1921, Spec. Rep. III, p. 63), has been very briefly described and is not included in the above key. It appears to be most nearly related to *P. kaupi* and *P. japonicus.*

## Genus **Physiculus**, Kaup

*Physiculus*, Kaup, 1858, *Arch. Naturgesch.*, XXIV (1), p. 88. Type *Physiculus dalwigkii*, Kaup.
*Pseudophycis*, Günther, 1862, *Cat. Fish.*, IV, p. 350. Type *Lota breviuscula*, Richardson.
*Leptophycis*, Garman, 1899, *Mem. Mus. Comp. Zoöl.*, XXIV, p. 182. Type *Leptophycis filifer*, Garman.

**Physiculus bachus** (Schneider).

*Enchelyopus bachus*, (Forster) Schneider, 1801, in Bloch, *Syst. Ichth.*, p. 53.
*Lota breviuscula*, Richardson, 1846, *Zool. 'Erebus' and 'Terror'*, Fish., p. 61, pl. xxxviii, fig. 1; Günther, 1862, *Cat. Fish.*, IV, p. 350.
*Lotella bacchus*, Günther, 1862, *t.c.*, p. 347; Hutton, 1872, *Fish. N. Zealand*, p. 46.
*Physiculus bachus*, Waite, 1911, *Rec. Canterbury Mus.*, I, p. 183, pl. xxxi, fig. 1; Phillipps, 1927, *N. Zealand Mar. Dept. Fish. Bull.*, I, p. 23; McCulloch, 1929, *Mem. Austral. Mus.*, V, p. 129.

*Hab.* New South Wales; South Australia; New Zealand.

In the British Museum 13 specimens, 92–550 mm. in total length.

**Physiculus barbatus** (Günther).

*Pseudophycis barbatus*, Günther, 1863, *Ann. Mag. Nat. Hist.* (3) XI, p. 116.
*Physiculus palmatus*, Klunzinger, 1872, *Arch. Naturgesch.*, XXXVIII (1), p. 38.
*Lotella grandis*, Ramsay, 1881, *Proc. Linn. Soc. N.S. Wales*, V, p. 462.
*Physiculus barbatus*, McCulloch, 1929, *Mem. Austral. Mus.*, V, p. 128.

*Hab.* South-eastern Australia and Tasmania; New Zealand.

In the British Museum 3 specimens, 260–430 mm. in total length, including the type of the species, a stuffed specimen, 430 mm. long, from Victoria.

Perhaps identical with the preceding species.

**Physiculus marginatus** (Günther).

For synonymy, etc. see pp. 53–54.

**Physiculus rastrelliger, Gilbert.**

1891, *Proc. U.S. Nat. Mus.*, XIII, p. 113; Jordan and Evermann, 1898, *Bull. U.S. Nat. Mus.*, XLVII (3), p. 2549; Garman, 1899, *Mem. Mus. Comp. Zoöl.*, XXIV, p. 189, pl. lxxxii, fig. 2.

? *Leptophycis filifer*, Garman, 1899, *t.c.*, p. 182, pl. xli, fig. 2.

*Hab.* Pacific coast of America from Lower California to Colombia.

In the British Museum a single specimen, 110 mm. in total length.

**Physiculus capensis, Gilchrist.**

1922, *Fish. Mar. Surv. S. Afr.*, II, 1921, Spec. Rep. III, p. 62; Barnard, 1925, *Ann. S. Afric. Mus.*, XXI, p. 326.

*Hab.* South Africa.

In the British Museum a single specimen, 105 mm. in total length.

**Physiculus fulvus, Bean.**

1885, *Proc. U.S. Nat. Mus.*, VII (1884), p. 240; Goode and Bean, 1895, *Ocean. Ichth.*, p. 366, fig. 319; Jordan and Evermann, 1898, *Bull. U.S. Nat. Mus.*, XLVII (3), p. 2547, fig. 896.

*Hab.* Caribbean Sea and northwards in the Gulf Stream.

**Physiculus nematopus, Gilbert.**

1891, *Proc. U.S. Nat. Mus.*, XIII, p. 114; Jordan and Evermann, 1898, *Bull. U.S. Nat. Mus.*, XLVII (3), p. 2548.

? *Physiculus longipes*, Garman, 1899, *Mem. Mus. Comp. Zoöl.*, XXIV, p. 188, pl. xlii, fig. 2.

*Hab.* Coast of southern California; Bay of Panama (?).

In the British Museum a single specimen, 132 mm. in total length.

**Physiculus argyropastus, Alcock.**

1893, *J. Asiat. Soc. Bengal*, LXII (2), p. 180, pl. ix, fig. 2; *Illust. Zool. 'Investigator'*, Fishes, pl. xxii, fig. 1; Alcock, 1899, *Cat. Indian Deep-Sea Fish.*, p. 77.

*Hab.* Indian seas.

In the British Museum 12 specimens, 55–225 mm. in total length, including a paratype of the species.

**Physiculus nigrescens, Radcliffe.**

1912, *Proc. U.S. Nat. Mus.*, XLIII, p. 105, pl. xxii, fig. 1.

*Hab.* Philippines.

This species may be identical with *P. peregrinus*.

**Physiculus grinnelli, Jordan and Jordan.**

1922, *Mem. Carnegie Mus.*, X, p. 22, pl. i, fig. 3.

*Hab.* Hawaiian Islands.

**Physiculus roseus, Alcock.**

1891, *Ann. Mag. Nat. Hist.* (6) VIII, p. 28; *Illust. Zool. 'Investigator'*, Fishes, pl. xi, fig. 2; Alcock, 1899, *Cat. Indian Deep-Sea Fish.*, p. 76.

*Hab.* Andaman Sea.

In the British Museum a single specimen (paratype), 165 mm. in total length.

**Physiculus dalwigkii**, Kaup.

1858, *Arch. Naturgesch.*, XXIV (1), p. 88; Günther, 1862, *Cat. Fish.*, IV, p. 348; Günther, 1887, *Deep-Sea Fish. 'Challenger'*, p. 88; Vaillant, 1888, *Expéd. Sci. 'Travailleur' et 'Talisman'*, Poiss., p. 290, pl. xxv, fig. 3.

*Hab.* Madeira; off Soudan.

In the British Museum 3 specimens, 215–240 mm. in total length.

**Physiculus kaupi**, Poey.

1865, *Repert. Fis.-Nat. Cuba*, I, p. 186, pl. iv, fig. 1; Goode and Bean, 1895, *Ocean. Ichth.*, p. 366; Jordan and Evermann, 1898, *Bull. U.S. Nat. Mus.*, XLVII (3), p. 2548.

*Hab.* Deep waters of the Atlantic.

In the British Museum 2 specimens, 230–265 mm. in total length.[1]

**Physiculus japonicus**, Hilgendorf.

1879, *SitzBer. naturf. Freunde Berlin*, p. 80; Franz, 1910, *Abh. Bayer. Akad. Wiss.*, Suppl. IV, Abh. 1, pp. 27, 111, pl. v, fig. 20, pl. x, figs. 10, 11; Jordan and Hubbs, 1925, *Mem. Carnegie Mus.*, x, p. 326.

*Physiculus kaupi* (part), Günther, 1887, *Deep-Sea Fish. 'Challenger'*, p. 88, pl. xvii, fig. A.

*Physiculus dalwigkii*, Steindachner and Döderlein, 1887, *Denkschr. Akad. Wiss. Wien.*, LIII, p. 279.

*Hab.* Japan.

In the British Museum 3 specimens, 280–375 mm. in total length.

**Physiculus peregrinus** (Günther).

*Pseudophycis peregrinus*, Günther, 1871, *Proc. Zool. Soc.*, p. 669.

*Physiculus peregrinus*, Günther, 1887, *Deep-Sea Fish. 'Challenger'*, p. 88; Weber and Beaufort, 1929, *Fish. Indo-Austral. Arch.*, v, p. 9.

*Hab.* Philippines.

In the British Museum a single specimen, 135 mm. in total length—type of the species.

**Physiculus longifilis**, Weber.

1913, *Fische 'Siboga'-Exped.*, p. 178, pl. v, fig. 6; Weber and Beaufort, 1929, *Fish. Indo-Austral. Arch.*, v, p. 10, fig. 3.

*Hab.* Flores Sea.

**Physiculus edelmanni**, Brauer.

1906, *Tiefsee-Fische 'Valdivia'*, p. 274, pl. xii, fig. 6.

*Hab.* Deep water off the coast of East Africa.

Brauer had 3 specimens of this species, 150–223 mm. in total length, none of which showed any trace of a barbel.

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[1] The tail has been broken in both specimens.

## Genus **Lotella**, Kaup

*Lotella*, Kaup, 1858, *Arch. Naturgesch.*, xxiv (1), p. 88. Type *Lota phycis*, Schlegel.

This genus is very close to *Physiculus*, but is readily distinguished by the outer series of enlarged teeth in each jaw. In addition, the scales are smaller and the pelvic fins have rather broader bases.

**Lotella fernandeziana**, Rendahl.

*Lotella rhacinus* (*non* Forster), Steindachner, 1898, *Zool. Jahrb.*, Suppl. iv, p. 325; Delfin, 1901, *Cat. Peces Chile*, p. 100.
*Lotella phycis* (*non* Schlegel), Steindachner, 1903, *Zool. Jahrb.*, Suppl. vi, p. 208.
*Lotella fernandeziana*, Rendahl, 1921, *Nat. Hist. J. Fernandez and Easter Isd.*, iii, p. 53.

*Hab.* Juan Fernandez.

The British Museum has received a fine specimen (275 mm. long) through Mr Cavendish Bentinck, collected by Dr Lengerich. This species is closely related to *L. callarias*, Günther, from Australian seas, which may prove to be identical with *L. rhacinus* (Forster), from New Zealand. Other species are *L. phycis* (Schlegel) from Japan, and *L. fuliginosa*, Günther, from an unknown locality. *L. maxillaris*, Bean, from the Gulf Stream, is probably not a member of this genus.

## MURAENOLEPIDAE

**Muraenolepis microps**, Lönnberg.

*Muraenolepis marmoratus microps*, Lönnberg, 1905, *Wiss. Ergebn. Schwed. Südpol.-Exped.*, v (6), p. 43.
*Muraenolepis microps*, Regan, 1914, *Brit. Antarct.* ('*Terra Nova*') *Exped.* 1910, Zool., i (1), p. 1, pl. ii, fig. 2.

St. WS 82. 21. iii. 27. 54° 06′ S, 57° 46′ W. Commercial otter trawl, 140–144 m.: 1 specimen, 190 mm.

Depth of body about 5 in the length, length of head $4\frac{3}{4}$. Diameter of eye $5\frac{1}{2}$ in length of head, much less than interocular width, greater than interorbital width. Length of barbel about $\frac{1}{7}$ that of head. Length of pelvic nearly $\frac{2}{3}$ that of head. Dorsal filament longer than diameter of eye.

*Hab.* Burdwood Bank, south of the Falkland Islands; South Georgia; Antarctic Seas.

This species appears to belong more properly to the true Antarctic region, the fishes of which will be dealt with in a later report.

**Muraenolepis orangiensis**, Vaillant. "Yallich Lif" or "Yakouchlif".

1888, *Miss. Sci. Cap Horn*, vi. Zool., Poiss., p. 20, pl. iv, fig. 2.

St. WS 825. 28–29. i. 32. 50° 50′ S, 57° 15′ 15″ W. Commercial otter trawl with net attached, 135–144 m.: 1 specimen, 192 mm.

Depth of body $6\frac{2}{3}$ in the length, length of head $6\frac{1}{3}$. Diameter of eye 5 in length of head, about equal to interocular width, much greater than interorbital width. Length of barbel about $\frac{1}{5}$ that of head. Length of pelvic $\frac{5}{6}$ that of head. Dorsal filament 3 times as long as diameter of eye.

*Hab.* Patagonian-Falklands region; Straits of Magellan.

The type of the species from Orange Bay was only 63 mm. long. The species was not previously represented in the British Museum collection.

The known species of *Muraenolepis* may be distinguished as follows:

I. Depth of body $6\frac{2}{3}$, length of head $6\frac{1}{3}$ in that of fish; dorsal filament 3 times as long as eye ... ... ... ... ... ... ... ... ... ... *orangiensis.*

II. Depth of body 5 to 6, length of head $4\frac{1}{2}$ to $5\frac{1}{4}$ in that of fish; dorsal filament less than twice as long as eye.

  A. Length of head $5\frac{1}{4}$ in that of fish; eye about 4 in head; dorsal filament as long as eye ... ... ... ... ... ... ... ... ... ... *marmoratus.*

  B. Length of head $4\frac{1}{2}$ to $4\frac{3}{4}$ in that of fish; eye 5 in head; dorsal filament longer than eye ... ... ... ... ... ... ... ... ... ... *microps.*

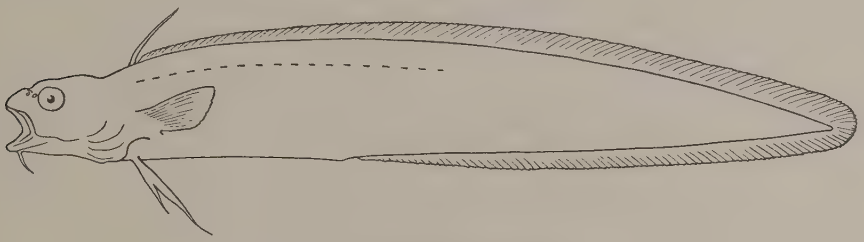

Fig. 25. *Muraenolepis orangiensis.* × $\frac{2}{3}$.

## LAMPRIDIDAE

**Lampris regius** (Bonnaterre).

There is a stuffed specimen, about 3 feet in length, in the Museum at Stanley, of which a photograph has been sent to me by Mr Hamilton. This fish, which was found at West Point Island, Falkland Islands, appears to be referable to this species. This is the first record of the Opah or Moon-fish from South America, but it is known from Australia and New Zealand.

## CARANGIDAE

**Parona signata** (Jenyns).

*Paropsis signatus*, Jenyns, 1842, *Zool. 'Beagle'*, Fish., p. 66, pl. xiii; Günther, 1860, *Cat. Fish.*, II, p. 486; Steindachner, 1876, *SitzBer. Akad. Wiss. Wien*, LXXII (1), p. 77; Lütken, 1880, *Vidensk. Selsk. Skr.* (5) XII, 6, p. 104; Perugia, 1891, *Ann. Mus. Civ. stor. nat. Genova* (2) X [XXX], p. 614.

*Parona signata*, Berg, 1895, *Anal. Mus. Nac. B. Aires*, IV, p. 39; Evermann and Kendall, 1906, *Proc. U.S. Nat. Mus.*, XXXI, p. 99; Devincenzi, 1924, *Anal. Mus. Montevideo* (II) I (5), p. 218; Fowler, 1927, *Proc. Acad. N.S. Philad.*, LXXVIII, p. 268; Devincenzi and Barattini, 1928, *Anal. Mus. Montevideo* (II) II (4), pl. xxiv, fig. 2.

St. WS 847. 9. ii. 32. 50° 15′ 45″ S, 67° 57′ W. Commercial otter trawl, 51–56 m.: 6 specimens, 465–600 mm.

Depth of body $2\frac{1}{5}$ to nearly $2\frac{1}{2}$ in the length, length of head $3\frac{4}{5}$ to a little more than 4. Snout as long as (young) or longer than eye, diameter of which is $3\frac{1}{2}$ (young) to $6\frac{1}{2}$ in length of head and less than interorbital width. Maxillary extending to beyond eye in adults; lower jaw projecting; bands of very small conical teeth in both jaws, tapering to nearly a single series posteriorly. 14 or 15 long, slender gill-rakers on lower part of anterior arch. Dorsal VI–VII, I 32–39; preceded by a recumbent, anteriorly-directed spine, which is generally more or less embedded under the skin. Anal II, I 34–37. Length of pectoral $1\frac{1}{2}$ to $1\frac{3}{4}$ in that of head. Silvery, back darker; an elongate horizontal black blotch on side beneath the pectoral fin.

*Hab.* Coasts of southern Brazil, Uruguay and Argentina; Patagonian-Falklands region.

In addition to the above, there is a large specimen in the British Museum collection from Buenos Aires, a very small one from Rio Grande do Sul, and the type of the species (about 220 mm.) from Bahia Blanca, Northern Patagonia.

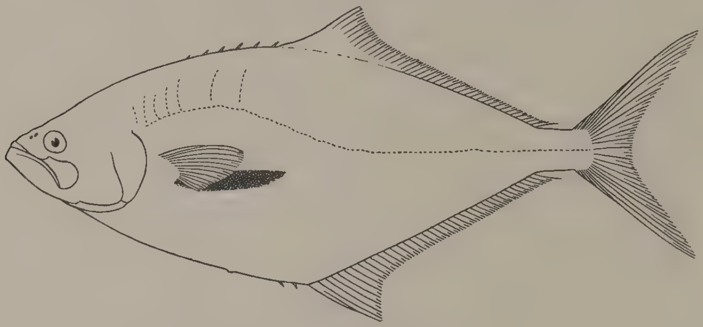

Fig. 26. *Parona signata.* $\times \frac{1}{4}$.

## CHEILODACTYLIDAE

**Cheilodactylus bergi, sp.n.**

*Chilodactylus macropterus* (*non* Schneider), Perugia, 1891, *Ann. Mus. Civ. stor. nat. Genova* (2) x [xxx], p. 612; Berg, 1895, *Anal. Mus. Nac. B. Aires*, iv, p. 60; Lönnberg, 1907, *Hamb. Magalh. Sammelr.*, Fische, p. 7; Ribeiro, 1915, *Arch. Mus. Nac. Rio Janeiro*, xvii, Chilodactylidae, p. 2, fig.; Devincenzi, 1924, *Anal. Mus. Montevideo* (ii) i (5), p. 227; Fowler, 1927, *Proc. Acad. N.S. Philad.*, lxxviii, p. 272.

15. iii. 32. Port Madryn, Argentina. Hand line, 2 m.: 1 specimen, 142 mm.

Depth of body $2\frac{3}{5}$ to nearly 3 in the length, length of head $3\frac{1}{3}$ to $3\frac{3}{5}$. Snout longer than eye, diameter of which is $3\frac{3}{4}$ to 4 in length of head and about equal to interorbital width. Scales on upper surface of head not extending forward beyond a line between the nostrils. Maxillary extending to below the nostrils. 14 or 15 gill-rakers on lower part of anterior arch. 50 to 54 scales in a longitudinal series, 5 or 6 from origin of dorsal to lateral line. Dorsal XVII–XVIII 25–26; seventh spine apparently longest, its length about $\frac{1}{2}$ that of head. Anal III 14–15; second spine stronger and a little longer than third, its length about equal to diameter of eye. Pectoral with 6 simple rays, the uppermost (or sometimes the second) greatly prolonged, much longer than head, extending to above anterior soft-rays of anal. Supra-cleithrum about as broad as eye. Silvery, darker above, with some irregular and indistinct darker patches on head and body; a large diffuse dark blotch at commencement of lateral line, connected with that of the opposite side by a broad band passing just in front of the first dorsal spine; membrane of spinous dorsal fin dusky.

*Hab.* Coast of South America from Rio de Janeiro southwards [to the Straits of Magellan?].

In addition to the specimen mentioned above, two others (340, 365 mm.) from off the coast of Uruguay (34° S, 50° W), presented to the British Museum by Dr Marini, have been included in the description. The smaller of these two specimens (340 mm.) has been selected as the holotype.

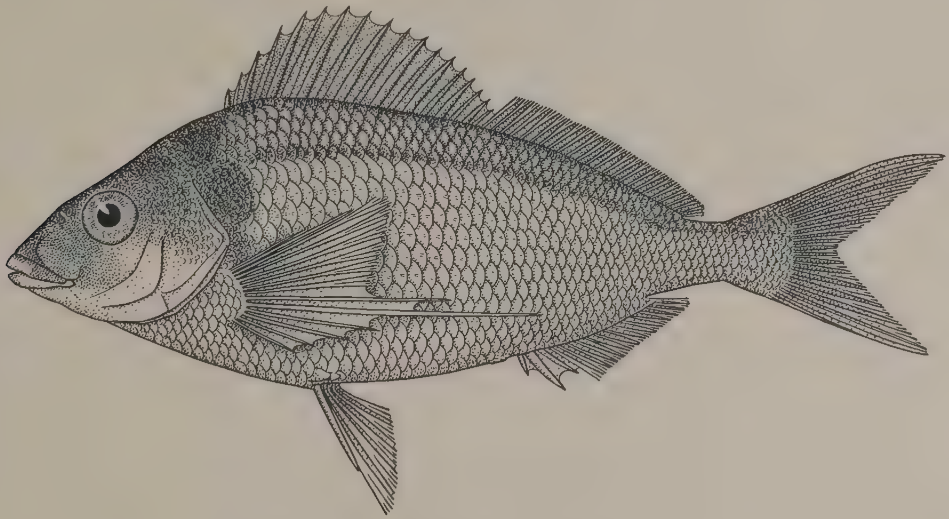

Fig. 27. *Cheilodactylus bergi.* Holotype. × $\frac{2}{5}$.

This species is very closely related to *C. macropterus* (Schneider) from Australia and New Zealand, but may be at once recognized by the much broader supra-cleithrum. According to Gill's synopsis of the Cirrhitiform Percoids (1862, *Proc. Acad. N.S. Philad.*, p. 114) this species would fall into the genus *Dactylopagrus*,[1] but it seems doubtful whether the groups *Dactylopagrus*, *Acantholatris* and *Chirodactylus* erected by this author are worthy of more than subgeneric rank at the most.

**Cheilodactylus gayi**, Kner.

*Cheilodactylus carmichaelis* (*non* Cuvier and Valenciennes, 1830), Cuvier and Valenciennes, 1833, *H.N. Poiss.*, IX, p. 489; Guichenot, 1848–9, in Gay, *Hist. Chile*, Zool. II, p. 197; Valenciennes, 1850, in Cuvier, *R. Anim.*, Disciples Ed., Poiss., pl. XXXI, fig. 2.

*Chilodactylus gayi*, Kner, 1869, *Reise 'Novara'*, Zool., I, 5, Fische, p. 92.

*Chilodactylus monodactylus* (*non* Carmichael), Steindachner, 1875, *SitzBer. Akad. Wiss. Wien*, LXXI (1), p. 456; Günther, 1880, *Shore Fish. 'Challenger'*, p. 24; Delfin, 1901, *Cat. Peces Chile*, p. 70; Steindachner, 1903, *Zool. Jahrb.*, Suppl. VI, p. 205; Rendahl, 1921, *Nat. Hist. J. Fernandez and Easter Isd.*, III, p. 55.

Depth of body $2\frac{2}{3}$ to nearly 3 in the length, length of head about $3\frac{3}{5}$. Snout (measured to tip of upper lip) $1\frac{3}{4}$ times as long as eye, diameter of which is about 4 in length of head and a little less than interorbital width. Scales on upper surface of head extending forward to a little beyond a line between the anterior nostrils. Maxillary extending to below the anterior nostril. 14 gill-rakers on lower part of anterior arch. 53 to 56 scales in a longitudinal series, 7 from origin of dorsal to lateral line. Dorsal XVII 25; seventh spine longest, its length about ½ that of head. Anal III 12; second spine very stout and much longer than third, its length 2½ in that of head. Pectoral with 6 simple rays, the uppermost or second prolonged, extending to above anterior part of anal, length of fin (measured from axil to tip of longest ray) 1⅗ to 1⅔ times that of head. Supra-cleithrum narrow, about ½ as broad as eye. Brownish above, silvery below; scales on upper parts of body with silvery centres, giving the appearance of longitudinal stripes; an indistinct dark band on the back in front of the dorsal fin, connecting the pectoral fins; a dark patch below the eye and another on the edge of the operculum.

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[1] Misprinted *Dactylosparus* on p. 117.

*Hab.* Juan Fernandez.

Described from 2 specimens, 360 and 370 mm. in total length, collected by the 'Challenger' Expedition.

This species, which falls into the group *Acantholatris* of Gill, is closely related to *C. monodactylus* (Carmichael) from Tristan da Cunha and Gough Island. In that species, however, the head is a little larger (3⅕ to 3⅓ in length of body), the diameter of the eye is about 4½ in length of head and 1¼ to 1⅓ in the interorbital width (in adults); the maxillary extends to below the posterior nostril; there are 16 or 17 gill-rakers on the lower part of the anterior arch; there are 50 to 52 scales in a longitudinal series; the longest dorsal spine is less than ½ the length of the head; the pectoral fin is as long as or a little longer than the head, the prolonged ray extending to above the vent or not as far; and there are 5 or 6 dark cross-bars on the upper parts of the sides.

## PINGUIPEDIDAE

### Parapercis chilensis, sp.n.

St. WS 742. 5. xi. 31. 38° 22′ S, 73° 41′ W. Small beam trawl, 58 m.: 3 specimens, 102–270 mm. (holotype 270 mm.).

Depth of body 4¼ to 4¾ in the length, length of head about 3¼. Snout as long as or a little longer than eye, diameter of which is 3¾ to 4½ in length of head and 1½ times to twice the interorbital width. Maxillary extending to or nearly to the anterior margin of the eye; teeth in broad villiform bands in both jaws, those of the outer series enlarged but not canine-like; vomer and palatines toothless. Upper surface of head, cheeks and opercles scaled; margin of praeoperculum smooth. 9 short gill-rakers on lower part of anterior arch. Scales ciliated; 70 to 75 in a longitudinal series, 11 or 12 between dorsal spines and lateral line. Dorsal IV 27–28; spines increasing in size to the last, which is about as long as eye and ⅗ as long as the first soft-ray. Anal 22–23. Pectoral ¾ to ⅘ as long as head. Pelvics extending to or nearly to origin of anal. Caudal subtruncate; caudal peduncle about as deep as long. Brownish, with some indistinct dark markings on the body which tend to form irregular cross-bars; dorsal and caudal fins dusky; rays of the anal tipped with yellowish-white; pectoral pale, with a dark crescentic spot at its base.

*Hab.* Mocha Island, Chile.

This species appears to be most nearly related to *P. gilliesii* (Hutton) from New Zealand, but has one more spine in the dorsal fin, a greater number of dorsal and anal rays, smaller scales, and a broader interorbital region. The absence of teeth on the vomer distinguishes it from this and from all other species of *Parapercis*, but I am not inclined to erect a new genus for its reception on this account. McCulloch (1914, *Biol. Res.* '*Endeavour*', ii, p. 154) has shown that the palatine teeth are sometimes absent and sometimes present in certain species of *Parapercis*, and in *P. gilliesii* the vomerine teeth are only 3 or 4 in number.

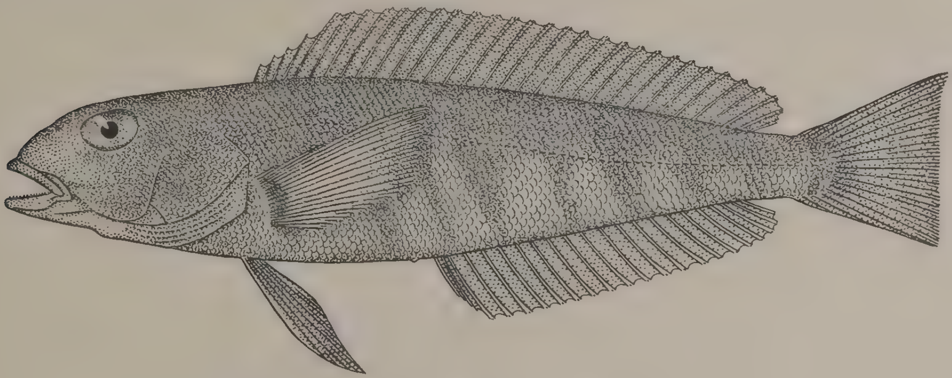

Fig. 28. *Parapercis chilensis*. Holotype. × ½.

## BOVICHTHYIDAE

**Cottoperca gobio** (Günther). "Yakouroum."

? *Batrachus trigloides*, Schneider [*ex* Forster MS.], 1801, in Bloch, *Syst. Ichth.*, p. 44.

? *Callionymus trigloides*, Forster, 1844, *Descript. Anim.*, p. 358.

*Aphritis gobio*, Günther, 1861, *Ann. Mag. Nat. Hist.* (3) vii, p. 88; Cunningham, 1871, *Trans. Linn. Soc. London*, xxvii, p. 469; Günther, 1880, *Shore Fish. 'Challenger'*, p. 21, pl. ix; Günther, 1881, *Proc. Zool. Soc.*, p. 20; Perugia, *Ann. Mus. Civ. stor. nat. Genova* (2) x [xxx], p. 615.

*Cottoperca rosenbergii*, Steindachner, 1876, *SitzBer. Akad. Wiss. Wien*, lxxii (1), p. 67, pl. v, fig. 1; Vaillant, 1888, *Miss. Sci. Cap Horn*, vi. Zool., Poiss., p. 28, pl. iv, fig. 1.

*Cottoperca gobio*, Smitt, 1898, *Bih. Sv. Vet.-Akad. Handl.*, xxiv, iv, No. 5, p. 13, pl. i, fig. 16, pl. ii, figs. 18–20; Berg, 1899, *Comun. Mus. Nac. B. Aires*, i, p. 173; Delfin, 1901, *Cat. Peces Chile*, p. 84; Regan, 1913, *Trans. R. Soc. Edinb.*, xlix, p. 253, pl. iv, fig. 3; Devincenzi, 1924, *Anal. Mus. Montevideo* (ii) i (5), p. 264.

*Pseudaphritis gobio*, Lönnberg, 1905, *Wiss. Ergebn. Schwed. Südpol.-Exped.*, v (6), pp. 8, 16; Lönnberg, 1907, *Hamb. Magalh. Sammelr.*, Fische, p. 10; Thompson, 1916, *Proc. U.S. Nat. Mus.*, l, p. 423.

*Cottoperca macrocephala*, Roule and Despax, 1911, *Bull. Mus. Paris*, xvii, p. 277; Roule, Angel and Despax, 1913, *Deux. Expéd. Antarct. Franç.* (1908–1910), Poiss., p. 7, pl. i, fig. 2, pl. iii, fig. 4.

*Cottoperca macrophthalma*, Regan, 1913, *Trans. R. Soc. Edinb.*, xlix, p. 253, pl. iv, fig. 2, pl. v, fig. 2.

St. WS 73. 6. iii. 27. 51° 01′ S, 58° 54′ W. Commercial otter trawl, 121 m.: 3 specimens, 190–270 mm.

St. WS 77. 12. iii. 27. 51° 01′ S, 66° 31′ 30″ W. Commercial otter trawl, 110–113 m.: 2 specimens, 230, 235 mm.

St. WS 79. 13. iii. 27. 51° 01′ 30″ S, 64° 59′ 30″ W. Commercial otter trawl, 132–131 m.: 4 specimens, 195–330 mm.

St. WS 83. 24. iii. 27. 14 miles S 64° W of George Island, East Falkland Islands. Commercial otter trawl, 137–129 m.: 22 specimens, 120–305 mm.

St. WS 85. 25. iii. 27. 8 miles S 66° E of Lively Island, East Falkland Islands. Commercial otter trawl, 79 m.: 9 specimens, 120–380 mm.

St. WS 97. 18. iv. 27. 49° 00′ 30″ S, 61° 58′ W. Commercial otter trawl, 146–145 m.: 1 specimen, 355 mm.

St. WS 221. 4. vi. 28. 48° 23′ S, 65° 10′ W. Tow-net attached to back of trawl, 76–91 m.: 1 specimen, 45 mm.

St. WS 583. 2. v. 31. 53° 39′ S, 70° 54′ 30″ W. Small beam trawl, 14–78 m.: 3 specimens, 86–130 mm.

9. v. 31. Puerto Acero. Hand line, 23 m.: 1 specimen, 360 mm.

St. WS 781. 6. xi. 31. 50° 30′ S, 58° 50′ W. Commercial otter trawl, 148 m.: 1 specimen, 240 mm.

St. WS 787. 7. xii. 31. 48° 44′ S, 65° 24′ 30″ W. Net (7 mm. mesh) attached to back of trawl, 106–110 m.: 2 specimens, 180, 182 mm.

St. WS 792. 15. xii. 31. 45° 49′ 30″ S, 62° 20′ 15″ W. Net (7 mm. mesh) attached to back of trawl, 102–106 m.: 1 specimen, 235 mm.

St. WS 803. 5. i. 32. 50° 33′ 45″ S, 62° 05′ 30″ W. Net (7 mm. mesh) attached to back of trawl, 173–186 m.: 1 specimen, 180 mm.

St. WS 804. 6. i. 32. 50° 22′ 45 S, 62° 49′ W. Commercial otter trawl, with nets attached, 150–143 m.: 2 specimens, 133, 135 mm.

St. WS 836. 3. ii. 32. 53° 05′ 30″ S, 67° 38′ W. Small beam trawl, 64 m.: 2 specimens, 170, 175 mm.

St. WS 878. 4. iv. 32. 52° 36′ S, 58° 54′ W. Rectangular net, 121 (–0) m.: 5 specimens, 37–80 mm.

Depth of body $3\frac{1}{3}$ to 5 in the length, length of head[1] $2\frac{1}{6}$ to $2\frac{2}{3}$. Snout (except in very young) longer than eye; diameter of which is 3 (young) to more than 7 in length of head (measured to opercular spine), and $1\frac{1}{4}$ to $2\frac{3}{5}$ in the distance from its posterior margin to upper angle of gill-opening; interorbital width 13 to 16 in length of head. Maxillary extending to below posterior part or hinder edge of eye, or a little beyond. 5 to 7 gill-rakers on lower part of anterior arch. Scales ciliated in the young, becoming smoother in adults; about 60 in a lateral longitudinal series. Dorsal VII (occasionally VI or VIII), 21–24; dorsal spines and rays increasing in length with age; longest soft-rays varying from $\frac{1}{3}$ to about $\frac{3}{4}$ length of head. Anal 20–24. Pectoral about $\frac{1}{2}$ as long as head; 6 (occasionally 5 or 7) lowest rays simple and somewhat thickened. Caudal subtruncate; caudal peduncle as deep as long or a little longer than deep. Brownish, blackish, or orange-yellow, the head and sides of the body spotted and marbled with darker; usually 3 irregular dark-brown saddle-like cross-bars on upper part of body; fins irregularly spotted or blotched with brown; soft dorsal sometimes dusky, with numerous round pale spots; membranous processes on sides yellowish-white.

*Hab.* Argentina; Patagonian-Falklands region; southern Chile.

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[1] Measured to tip of gill-cover.

In addition to the above, Mr Bennett has sent 3 specimens (140–340 mm.) caught by hook in 1½ fathoms at Stanley, Falkland Islands, in March, 1934. There are also 15 specimens (100–480 mm.) in the British Museum collection, from various localities in the Patagonian region, including the types of the species[1] and the types of *C. macrophthalma*.

Schneider's *Batrachus trigloides* was based upon the MS. and drawing of Forster (MS. IV, 44). I have seen the drawing, which is a poor pencil sketch, and this represents either a *Cottoperca* or *Notothenia*. Since the dorsal rays are given as VII, 22, and the anal rays 21, it would appear to belong to this genus.

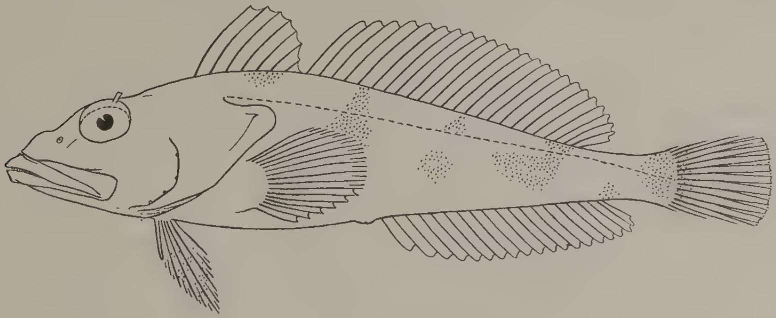

Fig. 29. *Cottoperca gobio*. × ½.

*Cottoperca gobio* exhibits considerable variation in the size of the eye, height of the fins, and in other features, but after carefully examining and tabulating about 70 specimens I am unable to recognize more than one species.[2] Judging from published descriptions and notes, the colour in life is also subject to considerable variation.

**Bovichtus argentinus**, MacDonagh.

*Bovichthys diacanthus* (*non* Carmichael), Berg, 1895, *Anal. Mus. Nac. B. Aires*, IV, p. 65; Berg, 1897, *Anal. Mus. Nac. B. Aires*, V, p. 298.

"*Bovichthys patagonicus*", (Berg) Regan, 1914, *Brit. Antarct.* ('*Terra Nova*') *Exped.* 1910, Zool. I (1), p. 26.

*Bovichthys argentinus*, MacDonagh, 1931, *Not. Prelim. Mus. La Plata*, I, p. 99; MacDonagh, 1934, *Rev. Mus. La Plata*, XXXIV, p. 77, pl. viii, fig. 2, pl. ix, pl. x, fig. 1, text-figs.

*Hab.* Coast of Argentina and northern Patagonia.

No specimens of this species were obtained by the expedition, but I am indebted to Mr MacDonagh for a young example (54 mm. in total length) from Puerto Madryn. The holotype (285 mm.) was taken in the Bahia del Fondo, Golfo San Jorge, and others have been recorded from La Plata. This species appears to be very close to *B. chilensis*, Regan, but seems to have a somewhat wider and more concave interorbital region. It is possible that comparison of specimens of similar size would show the two species to be identical.

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[1] The types are two skins, 400 and 420 mm. long, from Port Famine.

[2] Mr E. R. Gunther informs me that he studied a fairly large series of examples in a fresh condition, but was also unable to separate them into more than one species.

## NOTOTHENIIDAE

### *Key to the Patagonian genera*

I. Body scaly; gill-membranes forming a fold across the isthmus; opercles normal.
  A. Two or three lateral lines; maxillary usually extending to below eye; pectoral rounded or vertically truncated.
    1. Teeth usually in bands, but sometimes irregularly bi- or triserial with some of the teeth of the outer series enlarged and canine-like; snout not much longer than eye; usually less than 100 scales in a longitudinal series ... ... ... *NOTOTHENIA.*
    2. Teeth in upper jaw biserial, those of the outer row enlarged, spaced, canine-like; a group of stronger canine teeth on each praemaxillary; teeth in lower jaw uniserial, spaced, canine-like; snout much longer than eye; 110 to 120 scales in a longitudinal series ... ... ... ... ... ... ... ... ... *DISSOSTICHUS.*
  B. One lateral line; maxillary not reaching eye in the adult fish; pectoral very obliquely truncated, the upper rays longest ... ... ... ... ... ... *ELEGINOPS.*

II. Body naked; gill-membranes broadly united to isthmus; operculum hooked upwards posteriorly, its upper edge deeply concave; operculum and suboperculum each forming a strong spine ... ... ... ... ... ... ... ... ... *HARPAGIFER.*

### Genus **Notothenia**, Richardson

*Notothenia*, Richardson, 1844, *Zool. 'Erebus' and 'Terror'*, Fishes, p. 5; Günther, 1860, *Cat. Fish.*, II, p. 260; Regan, 1913, *Trans. Roy. Soc. Edinb.*, XLIX, p. 264. Type *N. coriiceps*, Richardson.

*Macronotothen*, Gill, 1862, *Proc. Acad. N.S. Philad.* (1861), p. 520. Type *Notothenia*? *rossii*, Richardson.

The problems raised by the study of the very rich material of this genus obtained by the Discovery Expedition have led me to undertake a new revision of the South American and Falkland Islands species, which amplifies and to some extent modifies those of Regan (1913) and Thompson (1916). This is one of the largest and most characteristic of the genera found in the Patagonian region, and the identification of the species is always a matter of some difficulty. As Regan has shown, the species of this region are very different from those of South Georgia, and, with one or two exceptions, are peculiar to it.

### *Key to the species of the Patagonian region*

I. Opercles fully scaled.
  A. Upper surface and sides of head scaled, including praeorbital and parts of snout; eye 3 in head (in a specimen of 190 mm.), interorbital width about 9; 42 tubular scales in upper lateral line, which extends to below fourth from last ray of dorsal ... *macrophthalma.*
  B. Upper surface and sides of head scaled, except snout and praeorbital; eye 3 (young) to 6 in head, interorbital width 4 to 8.
    1. 60 to 65 tubular scales in upper lateral line; lower jaw more or less strongly projecting; 9 or 10 rows of scales between the eyes.
      *a.* 3 lateral lines; jaws without distinct canines ... ... ... ... *trigramma.*
      *b.* 2 lateral lines; many of the teeth in the jaws spaced, canine-like ... ... *canina.*

2. 41 to 55 tubular scales in upper lateral line; jaws equal or lower a little projecting; 3 to 8 rows of scales between the eyes.

*a*. Upper lateral line ending below or a little behind last ray of dorsal; soft dorsal variegated with small, dark spots.

(i) 20 to 25 gill-rakers on lower part of anterior arch; longest dorsal spine at least $\frac{2}{3}$ head; scales on upper surface of head roughly ctenoid; pectoral $\frac{2}{3}$ to $\frac{4}{5}$ head ... ... ... ... ... ... ... ... *jordani.*

(ii) 14 to 16 gill-rakers on lower part of anterior arch; longest dorsal spine less than $\frac{1}{2}$ head; scales on upper surface of head smooth; pectoral $\frac{3}{5}$ to $\frac{2}{3}$ head ... ... ... ... ... ... ... ... ... *tessellata.*

*b*. Upper lateral line extending to well beyond last ray of dorsal; soft dorsal plain or with indistinct markings.

(i) Dorsal IV–V 34–37; least depth of caudal peduncle $\frac{2}{7}$ to $\frac{2}{5}$ length of head.

α. Eye $4\frac{1}{3}$ to $4\frac{1}{2}$ in head (in specimens of 120–155 mm.); 16 to 19 gill-rakers on lower part of anterior arch; least depth of caudal peduncle about $\frac{1}{3}$ length of head ... ... ... ... ... ... ... *brevicauda.*

β. Eye $3\frac{3}{4}$ to $4\frac{1}{3}$ in head (in specimens of 120–190 mm.); 19 to 23 gill-rakers on lower part of anterior arch; least depth of caudal peduncle less than $\frac{1}{3}$ length of head ... ... ... ... ... ... ... *guntheri.*

(ii) Dorsal VI–VIII (very occasionally V) 34–37; least depth of caudal peduncle $\frac{1}{4}$ to $\frac{2}{7}$ length of head.

α. 16 to 25 gill-rakers on lower part of anterior arch; interorbital width $4\frac{1}{5}$ to nearly $6\frac{1}{4}$ in head (narrower in young), eye 3 (young) to 5; scales on upper surface of head more or less ctenoid, except in large specimens, 6 to 8 rows between the eyes; pelvics rather shorter than pectorals, extending to or nearly to vent ... ... ... ... ... ... ... *ramsayi.*

β. 15 to 19 gill-rakers on lower part of anterior arch; interorbital width $5\frac{4}{5}$ to $7\frac{1}{3}$ in head, eye 4 to 5; scales on upper surface of head smooth, 5 or 6 rows between the eyes; pelvics shorter than pectorals, not or only just reaching vent ... ... ... ... ... ... ... ... ... *wiltoni.*

γ. 14 to 16 gill-rakers on lower part of anterior arch; interorbital width 7 to 8 in head, eye 3 to $3\frac{3}{5}$; scales on upper surface of head smooth, about 5 rows between the eyes; pelvics as long as or longer than pectorals, extending to origin of anal or beyond ... ... ... ... ... ... *longipes.*

3. 30 to 40 tubular scales in upper lateral line; jaws equal or lower a little projecting.

*a*. Depth $3\frac{2}{3}$ to 4 in length (without caudal); interorbital width $3\frac{3}{4}$ to $4\frac{1}{2}$ in head (narrower in young); 13 to 16 gill-rakers on lower part of anterior arch ... *squamiceps.*

*b*. Depth 4 to 5 in length (without caudal); interorbital width $5\frac{1}{2}$ to nearly 8 in head; 9 to 12 gill-rakers on lower part of anterior arch ... ... ... ... *sima.*

II. Opercles scaled only on upper part of operculum; upper surface of head naked.

A. Anal 27–32, length of base about 2 in that of fish (without caudal); interorbital width $4\frac{2}{3}$ to 13 in head; pelvics as long as or nearly as long as pectorals, extending to or nearly to vent; caudal peduncle deeper than long.

1. Interorbital width $4\frac{2}{3}$ to 6 in head; depth of body $3\frac{2}{3}$ to $4\frac{1}{2}$ in the length; generally 5 dorsal spines ... ... ... ... ... ... ... ... ... *cornucola.*

2. Interorbital width 10 to 13 in head; depth of body 6 to 7 in the length; 6 dorsal spines ... ... ... ... ... ... ... ... ... ... *elegans.*

B. Anal 22–25, length of base $2\frac{1}{3}$ to $2\frac{2}{3}$ in that of fish (without caudal); interorbital width $2\frac{1}{2}$ to $3\frac{1}{2}$ in head; pelvics much shorter than pectorals, not nearly reaching vent; caudal peduncle usually as long as deep or longer than deep.
  1. Scales smooth; 36 to 46 tubular scales in upper lateral line; 50 to 60 scales in a lateral longitudinal series ... ... ... ... ... ... ... *macrocephala.*
  2. Scales ctenoid; 51 to 56 tubular scales in upper lateral line; 67 to 73 scales in a lateral longitudinal series ... ... ... ... ... ... ... *microlepidota.*

**Notothenia macrophthalma, sp.n.**

St. WS 840. 53° 52′ S, 61° 49′ 15″ W. Commercial otter trawl, 368–463 m.: 1 specimen, 190 mm. Holotype.

Depth of body $4\frac{1}{2}$ in the length, length of head $3\frac{1}{3}$. Snout about $\frac{3}{4}$ diameter of eye, which is 3 in length of head; interorbital width about 9. Jaws about equal anteriorly; maxillary extending to below anterior $\frac{1}{5}$ of eye; teeth in bands, canines small; upper surface and sides of head, including praeorbital and parts of snout, scaled; scales on head ctenoid and mostly much smaller than those on body; 3 rows of scales between the eyes; 12 gill-rakers on lower part of anterior arch. Scales on body ctenoid; about 58 in a longitudinal series from above base of pectoral to caudal; 39 to 42[1] in upper lateral line, which ends below fourth from last ray of dorsal, 4 to 8 in lower lateral line. Dorsal VI 34; longest spine about $\frac{1}{3}$ length of head. Anal 30. Pectoral about $\frac{3}{4}$ the length of head, about as long as pelvics, which reach the vent. Caudal apparently rounded; caudal peduncle a little deeper than long. Body with broad, irregular cross-bars; cheek with two indistinct oblique stripes; dorsal fins partly blackish or dusky.

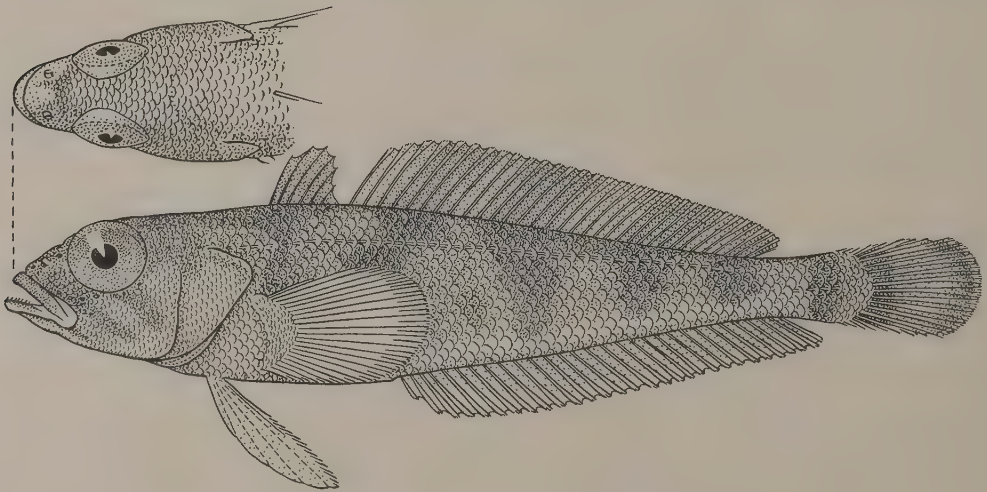

Fig. 30. *Notothenia macrophthalma.* Holotype. $\times\frac{4}{5}$.

*Hab.* Near the Burdwood Bank, south of the Falkland Islands.

Very closely related to *N. squamifrons*, Günther, from Kerguelen, but with a somewhat larger eye, larger scales in the interorbital region, fewer gill-rakers, rather fewer dorsal and anal rays, and a much shorter lower lateral line.

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[1] Counted on the two sides of the body.

### Notothenia trigramma, Regan.

*Notothenia trigramma*, Regan, 1913, *Trans. R. Soc. Edinb.*, XLIX, p. 266, pl. vi, fig. 2; Thompson, 1916, *Proc. U.S. Nat. Mus.*, L, p. 451.

Depth of body 5 in the length, length of head 4. Snout about as long as eye, diameter of which is 5 in length of head and equal to the interorbital width. Lower jaw projecting; maxillary extending to below anterior $\frac{1}{3}$ of eye; teeth in 3 to 5 rows anteriorly, those of the outer series enlarged but not canine-like; upper surface of head (except snout and praeorbital), cheeks and opercles covered with smooth scales; 9 or 10 rows of scales between the eyes; 15 gill-rakers on lower part of anterior arch. Scales on body ctenoid; about 85 in a lateral longitudinal series; 65 in upper lateral line, which nearly reaches caudal, 13 in line on middle of tail, and 40 to 45 in a third lower lateral line, which is separated by 4 or 5 longitudinal series of scales from the base of the anal fin. Dorsal VI 34; third spine longest, about $\frac{1}{3}$ length of head. Anal 32. Pectoral about $\frac{2}{3}$ the length of head, longer than pelvics, which do not reach vent. Caudal rounded; caudal peduncle about $\frac{2}{3}$ as long as deep, its least depth about $\frac{1}{3}$ length of head. Brownish; fins darker; a dark blotch on posterior part of spinous dorsal.

*Hab.* Falkland Islands.

Known only from the unique holotype, 280 mm. in total length, from Port Stanley, preserved in the Royal Scottish Museum, Edinburgh (Bruce Collection).[1] Quite apart from the presence of a third lateral line, this fish does not agree with any known species of *Notothenia*. It is most like *N. wiltoni*, which also occurs at the Falklands, but that species has only 48 to 53 scales in the upper lateral line, the lower jaw only a little longer than the upper, the head larger, and the interorbital region narrower.

### Notothenia canina, Smitt.

*Notothenia tessellata* forma *canina*, Smitt, 1897, *Bih. Sv. Vet.-Akad. Handl.*, XXIII, IV, No. 3, p. 25, pl. i, figs. 10, 11, pl. ii, figs. 20–22.

*Notothenia acuta* (*non* Günther), Steindachner, 1898, *Zool. Jahrb.*, Suppl. IV, p. 303; Delfin, 1901, *Cat. Peces Chile*, p. 86.

*Notothenia canina*, Boulenger, 1902, '*Southern Cross*', Pisces, p. 183; Regan, 1913, *Trans. R. Soc. Edinb.*, XLIX, p. 267; Hussakof, 1914, *Bull. Amer. Mus. Nat. Hist.*, XXXIII, p. 90; Thompson, 1916, *Proc. U.S. Nat. Mus.*, L, p. 455.

St. WS 89. 7. iv. 26. 9 miles N 21° E of Arenas Point Light, Tierra del Fuego. Commercial otter trawl, 23–21 m.: 2 specimens, 65, 138 mm.

St. WS 812. 10. i. 32. 51° 16′ 15″ S, 68° 52′ W. Net (7 mm. mesh) attached to back of trawl, 53–55 m.: 7 specimens, 68–115 mm.

St. WS 833. 1. ii. 32. 52° 30′ S, 68° 00′ W. Nets (4 and 7 mm. mesh) and seine net attached to back of trawl, 38–31 m.: 18 specimens, 85–135 mm.

St. WS 834. 2. ii. 32. 52° 57′ 45″ S, 68° 08′ 15″ W. Net attached to back of trawl, 27–38 m.: 8 specimens, 90–160 mm.

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[1] I am indebted to the authorities of the museum for the loan of this specimen for re-examination.

St. WS 835. 2. ii. 32. 53° 05′ 30″ S, 68° 06′ 30″ W. Small beam trawl, 14–16 m.: 44 specimens, 50–130 mm.

St. WS 836. 3. ii. 32. 53° 05′ 30″ S, 67° 38′ W. Small beam trawl, 64 m.: 4 specimens, 132–160 mm.

St. WS 847. 9. ii. 32. 50° 15′ 45″ S, 67° 57′ W. Commercial otter trawl, 51–56 m.: 1 specimen, 200 mm.

Depth of body 5 to 6 in the length, length of head $3\frac{1}{4}$ (young) to $3\frac{2}{3}$. Snout (except in young) as long as or a little longer than eye, diameter of which is 4 (young) to $5\frac{2}{3}$ in length of head; interorbital width 5 to $5\frac{1}{2}$. Lower jaw strongly projecting; maxillary extending to or nearly to below middle of eye; teeth irregularly bi- or triserial in upper jaw, uniserial in lower, those of outer series of upper jaw and most of those in lower jaw enlarged, spaced and canine-like; upper surface of head (except snout and praeorbital), cheeks and opercles covered with smooth scales; about 9 rows of scales between the eyes; 14 to 16 gill-rakers on lower part of anterior arch. Scales on body smooth; 78 to 84 in a lateral longitudinal series; 60 to 65 tubular scales in upper lateral line, which extends to midway between last ray of dorsal and caudal, 6 to 9 in lower lateral line. Dorsal VI 30–34; third spine generally longest, not more than $\frac{1}{3}$ length of head. Anal 30–32. Pectoral about $\frac{3}{4}$ the length of head; pelvics shorter, not reaching vent. Caudal rounded; caudal peduncle as deep as long or a little deeper than long. Pale brownish, with a lateral series of about 7 dark blotches or irregular cross-bars; spinous dorsal with a dark blotch; soft dorsal often with small spots arranged in rows; caudal with a narrow pale hinder margin.

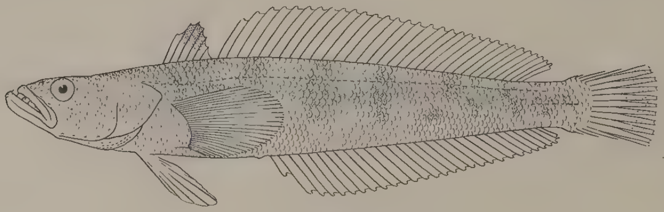

Fig. 31. *Notothenia canina.* × $\frac{1}{2}$.

*Hab.* Patagonian-Falkland region; Straits of Magellan.

This species, which was previously unrepresented in the British Museum collection, differs from almost all other species of the genus in the form and arrangement of the teeth, and in this respect it approaches *Dissostichus.* Steindachner's specimens from Tierra del Fuego, identified by him as *N. acuta,* Günther, clearly belonged to this species. Thompson has identified them as *N. tessellata,* but has overlooked Steindachner's description of the projecting lower jaw, large mouth cleft, unequal teeth, and the presence of 57 to 59 tubular scales in the upper lateral line. The types of the species, 90, 120 and 138 mm. in total length, were all from Puerto Gallegos, on the east coast of Patagonia, at a depth of 3 to 5 metres.

**Notothenia jordani, Thompson.**

*Notothenia jordani*, Thompson, 1916, *Proc. U.S. Nat. Mus.*, L, p. 443, pl. iii, fig. 3.

St. WS 90. 7. iv. 27. 13 miles N 83° E of Cape Virgins Light, Argentine Republic. Commercial otter trawl, 82–81 m.: 2 specimens, 160, 165 mm.

St. WS 833. 1. ii. 32. 52° 30′ S, 68° 00′ W. Nets (4 and 7 mm. mesh) and seine net attached to back of trawl, 38–31 m.: 9 specimens, 120–175 mm.

St. WS 834. 2. ii. 32. 52° 57′ 45″ S, 68° 08′ 15″ W. Seine net attached to back of trawl, 27–38 m.: 12 specimens, 55–120 mm.

St. WS 836. 3. ii. 32. 53° 05′ 30″ S, 67° 38′ W. Small beam trawl, 64 m.: 19 specimens, 110–220 mm.

Depth of body $4\frac{1}{4}$ to $4\frac{3}{4}$ in the length, length of head $3\frac{1}{3}$ to $3\frac{4}{5}$. Snout about as long as eye, diameter of which is 4 to 5 in length of head; interorbital width about 5. Lower jaw a little longer than upper; maxillary extending to below anterior part or middle of eye; teeth in bands, none enlarged; upper surface of head (except snout and praeorbital), cheeks and opercles covered with ctenoid scales, which do not extend forward beyond anterior edges of eyes; 3 to 5 rows of scales between the eyes. 20 to 25 rather long, fine gill-rakers on lower part of anterior arch. Scales on body ctenoid; 58 to 62 in a lateral longitudinal series; 43 to 48 tubular scales in upper lateral line, which extends to or very slightly beyond last ray of dorsal, 8 to 17 in lower lateral line. Dorsal VI–VIII (usually VII) 33–35; second spine generally longest, $\frac{2}{3}$ to $\frac{3}{4}$ length of head. Anal 31–33. Pectoral $\frac{2}{3}$ to $\frac{4}{5}$ the length of head, about as long as pelvics, which extend to or nearly to vent. Caudal rounded; caudal peduncle about as deep as long, its least depth $\frac{1}{4}$ or rather more than $\frac{1}{4}$ length of head. Pale brownish, with irregular broad dark cross-bars directed obliquely forward on upper parts of sides, continued on to the base of the soft dorsal, where they appear as dark blotches; usually a dark patch in the centre of the caudal peduncle; traces of yellowish-brown longitudinal stripes on sides; spinous dorsal dusky; soft dorsal with narrow, somewhat oblique, longitudinal stripes; anal uniformly pale or dusky at base; pectorals pale, with a dusky blotch across the base; pelvics yellowish.

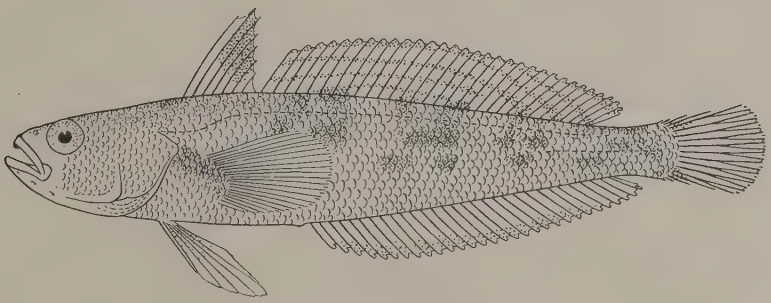

Fig. 32. *Notothenia jordani*. × $\frac{2}{3}$.

*Hab.* Patagonian-Falklands region; Straits of Magellan.

This species, which is new to the British Museum collection, was described by Thompson from numerous specimens from off the Gulf of St George, off Cape Virgins, just south of Cape Virgins, and between Cape Virgins and the First Narrows in the Straits of Magellan. The holotype (U.S.N.M. No. 76855) is 125 mm. long.

**Notothenia tessellata**, Richardson. "Siouna."

*Notothenia tessellata*, Richardson, 1845, *Zool. 'Erebus' and 'Terror'*, Fishes, p. 19, pl. xii, figs. 3, 4; Günther, 1860, *Cat. Fish.*, II, p. 260; Cunningham, 1871, *Trans. Linn. Soc. London*, XXVII, p. 469; Steindachner, 1876, *SitzBer. Akad. Wiss. Wien*, LXXII (1), p. 72, pl. v (right-hand fig.); Vaillant, 1888, *Miss. Sci. Cap Horn*, VI. Zool., Poiss., p. 24; Perugia, 1891, *Ann. Mus. Civ. stor. nat. Genova* (2) x [xxx], p. 618; Lönnberg, 1905, *Wiss. Ergebn. Schwed. Südpol.-Exped.*, v (6), p. 6; Lönnberg, 1907, *Hamb. Magalh. Sammelr.*, Fische, p. 8; Roule, Angel and Despax, 1913, *Deux. Expéd. Antarct. Franç.* (1908–1910), Poiss., p. 3; Regan, 1913, *Trans. R. Soc. Edinb.*, XLIX, p. 268; Hussakof, 1914, *Bull. Amer. Mus. Nat. Hist.*, XXIII, p. 89; Thompson, 1916, *Proc. U.S. Nat. Mus.*, L, p. 448.

*Notothenia veitchii*, Günther, 1874, *Ann. Mag. Nat. Hist.* (4) XIV, p. 370.

*Notothenia tessellata* (part), Günther, 1881, *Proc. Zool. Soc.*, p. 20; Smitt, 1897, *Bih. Sv. Vet.-Akad. Handl.*, XXIII, IV, No. 3, p. 25; Delfin, 1901, *Cat. Peces Chile*, p. 86.

*Notothenia brevipes*, Lönnberg, 1905, *Wiss. Ergebn. Schwed. Südpol.-Exped.*, v (6), p. 15.

? *Notothenia gilberti*, Thompson, 1916, *Proc. U.S. Nat. Mus.*, L, p. 430, pl. ii, fig. 3.

St. 51. 4. v. 26. Off Eddystone Rock, East Falkland Islands. Large otter trawl, 105–115 m.: 6 specimens, 135–160 mm.

St. 55. 16. v. 26. Entrance to Port Stanley, East Falkland Islands. Small beam trawl, 10–16 m.: 1 specimen, 100 mm.

St. WS 72. 5. iii. 27. 51° 07′ S, 57° 34′ W. Commercial otter trawl, 79 m.: 7 specimens, 85–130 mm.

St. WS 73. 6. iii. 27. 51° 01′ S, 58° 54′ W. Commercial otter trawl, 121 m.: 6 specimens, 130–200 mm.

St. WS 75. 10. iii. 27. 51° 01′ 30″ S, 60° 31′ W. Commercial otter trawl, 72 m.: 16 specimens, 130–220 mm.

St. 222. 23. iv. 27. St Martin's Cove, Hermite Island, Cape Horn. Large rectangular net, 30–35 m.: 1 specimen, 55 mm.

St. 223. 27. iv. 27. St Francis' Bay, Cape Horn. Large rectangular net, 63 m.: 3 specimens, 65–75 mm.

St. WS 576. 17. iv. 31. 51° 35′ S, 57° 49′ 45″ W. Commercial otter trawl, 34–24 m.: 1 specimen, 53 mm.

St. WS 582. 30. iv. 31. 53° 42′ 30″ S, 70° 55′ W. Hand line, 12 m.: 11 specimens, 125–175 mm.

2. v. 31. Bay San Nicolas. Hand line, 17 m.: 2 specimens, 137, 165 mm.

4. v. 31. Field Anchorage, Magellan Straits. Hand line, 26 m.: 3 specimens, 150–185 mm.

St. 724. 16. xi. 31. Fortescue Bay, Magellan Straits. Seine net, 0–5 m.: 10 specimens, 80–125 mm.

St. WS 872. 1. iv. 32. 53° 48′ S, 64° 18′ 30″ W. Commercial otter trawl, 139–141 m.: 1 specimen, 290 mm.

Depth of body $4\frac{1}{2}$ to 6 in the length, length of head $3\frac{1}{4}$ to $3\frac{2}{3}$. Snout (except in very young) as long as or longer than eye, diameter of which is $3\frac{1}{2}$ (young) to 6 in length of head; interorbital width $5\frac{1}{2}$ to $6\frac{3}{4}$ (narrower in young). Lower jaw rather prominent, the velum (measured from tip of jaw to edge of flap) at least $\frac{2}{3}$ diameter of eye in adults; maxillary extending to below anterior part or middle of eye; teeth in two rather irregular rows, those of the outer series somewhat enlarged anteriorly; upper surface of head (except snout), cheeks and opercles covered with smooth scales, which are often more or less embedded in the skin; 6 or 7 rows of scales between the eyes; 14 to

16 gill-rakers on lower part of anterior arch. Scales on body smooth or rather feebly ctenoid; 70 to 80 in a lateral longitudinal series; 41 to 48 tubular scales in upper lateral line, which ends below or a little behind last ray of dorsal, 6 to 11 in lower lateral line. Dorsal VI–VII 32–35; longest spine not more than $\frac{1}{3}$ length of head. Anal 31–34. Pectoral from less than $\frac{3}{5}$ to more than $\frac{2}{3}$ length of head, usually longer than the pelvics, which seldom reach origin of anal. Caudal rounded; caudal peduncle deeper than long. Body marbled, spotted and blotched with darker; spinous dorsal usually with a dense black spot covering greater part of fin, and with a narrow white edge; soft dorsal, caudal, and sometimes anal variegated with series of dark spots, the margins of the fins clear white.

*Hab.* Patagonian-Falklands region; Straits of Magellan; southern Chile, northwards to Chiloe.

In addition to the above, Mr Bennett has sent 9 specimens (150 to 240 mm.) from the Dockyard Jetty, Stanley, Falkland Islands, taken in a trap set in 1½ fathoms in November, 1933; as well as 8 others (140–225 mm.), collected near the beach at New Island, West Falklands, by Mr Hamilton in February, 1934. There are also 21 specimens (140–250 mm.) in the British Museum collection, including the types of the species, the types of *N. veitchii*, and 2 specimens (probably paratypes) of *N. brevipes*, received from Professor Lönnberg.

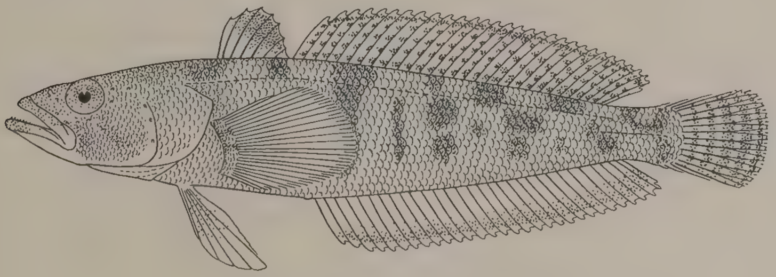

Fig. 33. *Notothenia tessellata.* × $\frac{2}{3}$.

Apart from the very short snout, I am unable to detect any differences between *N. gilberti* (based upon two specimens, both 60 mm. in total length) and young examples of *N. tessellata*. In an example of 53 mm. collected by the 'William Scoresby' the snout has been pushed inwards, giving the head an appearance very similar to that shown in the figure of *N. gilberti*.

This species is fairly common at the Falkland Islands, where it is known as "Rock Cod", a name given indiscriminately to all species of *Notothenia*. Mr Bennett notes that these fishes arrive round the shores in October and November, and disappear about the middle of April. They lurk around jetties, under rocks, and in the "kelp", becoming most active about sunset. Shags and seals are their natural enemies, but penguins may take toll of the smaller fish. They may be caught with a bait of raw lean mutton, but are not popular as food.

**Notothenia brevicauda, Lönnberg.**

? *Notothenia cyanobranchia* (*non* Richardson), Vaillant, 1888, *Miss. Sci. Cap Horn*, VI. Zool., Poiss., p. 26.

*Notothenia brevicauda*, Lönnberg, 1905, *Wiss. Ergebn. Schwed. Südpol.-Exped.*, V (6), p. 6, pl. V, fig. 16; Regan, 1913, *Trans. R. Soc. Edinb.*, XLIX, p. 269.

*Notothenia longicauda*, Thompson, 1916, *Proc. U.S. Nat. Mus.*, L, p. 445, pl. iv, fig. 1.

St. 56. 16. v. 26. Sparrow Cove, Port William, East Falkland Islands, $1\frac{1}{2}$ cables N 50° E of Sparrow Point. Small beam trawl, $10\frac{1}{2}$–16 m.: 2 specimens, 105, 140 mm.

Depth of body $4\frac{1}{2}$ to 5 in the length, length of head $3\frac{1}{4}$ to $3\frac{3}{5}$. Snout as long as or a little longer than eye, diameter of which is $4\frac{1}{3}$ to $4\frac{1}{2}$ (in specimens of 120–155 mm.) or 4 to $4\frac{1}{3}$ (in specimens of 85–120 mm.) in length of head; interorbital width 6 to 8. Jaws about equal anteriorly; maxillary extending to below anterior $\frac{1}{3}$ of eye; teeth in bands, those of the outer row enlarged anteriorly; upper surface of head (except snout and praeorbital), cheeks and opercles covered with smooth scales; 4 to 6 rows of scales between the eyes; scales absent across the occiput in the region of the occipital branch of the lateral line system; 16 to 19 gill-rakers on lower part of anterior arch. Scales on body ctenoid; 60 to 70 in a lateral longitudinal series; 44 to 50 tubular scales in upper lateral line, which ends 2 to 4 scales in front of caudal, 4 to 12 in lower lateral line. Dorsal V 35–37; longest spine not more than $\frac{2}{5}$ length of head; posterior rays of dorsal and anal (in adults) overlapping the caudal when laid back. Anal 32–35. Pectoral $\frac{3}{5}$ to $\frac{2}{3}$ length of head, as long as or a little shorter than pelvics, which extend to the anal or not quite as far. Caudal rounded; caudal peduncle $\frac{1}{2}$ to more than $\frac{2}{3}$ as long as deep, its least depth about $\frac{1}{3}$ (to $\frac{1}{2}$) length of head. Brownish or olivaceous; body with irregular dark cross-bars, which may extend on to base of soft dorsal; both dorsals and caudal usually more or less dusky, the soft dorsal and caudal narrowly margined with white; anal usually darker, often nearly black; pectorals yellowish; pelvics dusky.

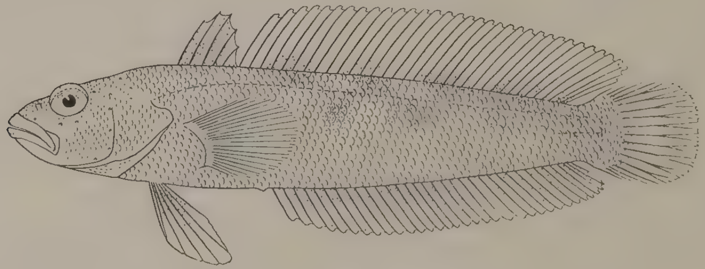

Fig. 34. *Notothenia brevicauda.* × $\frac{2}{3}$.

*Hab.* Falkland Islands; Straits of Magellan: in shallow water.

In addition to the above, Mr Bennett has sent one specimen (155 mm.) from Stanley, and another (140 mm.) from near the beach, New Island, West Falklands, collected by Mr Hamilton. There are also 8 specimens (85–180 mm.) in the British Museum collection, from the Falklands, Puerto Bueno, Fortescue Bay, and Port Famine.

*N. longicauda* was described by Thompson from 9 specimens, the largest 110 mm. long, all but the holotype (78 mm.) being in a poor state of preservation. The type was from Island Harbour, Patagonia; another was from Gregory Bay; and seven were from 'Albatross' Station 2771, at a depth of 50½ fathoms. I have examined one of these last, but it is in such a poor state as to be useless for comparison. After considering Thompson's description and figure, I agree with Regan (1916, *Ann. Mag. Nat. Hist.*, Ser. 8, XVIII, p. 379) that his type at least is referable to the species here identified as *N. brevicauda*. It is probable, however, that the examples taken by the 'Albatross' in deeper water may have belonged to the form described below as *N. guntheri*. The type of *N. brevicauda* from Ushuaia (120 mm. long without caudal), judging from Lönnberg's figure, has an exceptionally short and deep caudal peduncle, but is in other respects similar to specimens identified by Regan as this species.

**Notothenia guntheri**, sp.n. (Pl. I, fig. 1).

St. WS 86. 3. iv. 27. 53° 53′ 30″ S, 60° 34′ 30″ W. Commercial otter trawl, 151–147 m.: 41 specimens, 70–210 mm.

St. WS 87. 3. iv. 27. 54° 07′ 30″ S, 58° 16′ W. Commercial otter trawl, 96–127 m.: 1 specimen, 135 mm.

St. WS 93. 9. iv. 27. 7 miles S 80° W of Beaver Island, West Falkland Islands. Commercial otter trawl, 133–136 m.: 20 specimens, 95–170 mm.

St. WS 97. 18. iv. 27. 49° 00′ 30″ S, 61° 58′ W. Commercial otter trawl, 146–145 m.: 4 specimens, 130–180 mm.

St. WS 98. 18. iv. 27. 49° 54′ 15″ S, 60° 35′ 30″ W. Commercial otter trawl, 173–171 m.: 2 specimens, 175, 190 mm. (holotype, 190 mm.).

St. WS 225. 9. vi. 28. 50° 20′ S, 62° 30′ W. Net (7 mm. mesh) attached to back of trawl, 162–161 m.: 1 specimen, 165 mm.

St. 652. 14. iii. 31. Burdwood Bank, 54° 04′ S, 61° 40′ W. Large otter trawl, 171–169 m.: 3 specimens, 145–175 mm.

St. WS 781. 6. xi. 31. 50° 30′ S, 58° 50′ W. Commercial otter trawl, 148 m.: 1 specimen, 150 mm.

St. WS 804. 6. i. 32. 50° 21′ 15″ S, 62° 53′ W. Net (7 mm. mesh) attached to back of trawl, 143–150 m.: 1 specimen, 120 mm.

St. WS 814. 13. i. 32. 51° 45′ 15″ S, 66° 40′ W. Net (7 mm. mesh) attached to back of trawl, 111–118 m.: 1 specimen, 160 mm.

St. WS 825. 28–29. i. 32. 50° 50′ S, 57° 15′ 15″ W. Net (7 mm. mesh) attached to back of trawl, 135–144 m.: 1 specimen, 145 mm.

St. WS 841. 6. ii. 32. 54° 11′ 45″ S, 60° 21′ 30″ W. Net (7 mm. mesh) attached to back of trawl, 110–120 m.: 1 specimen, 160 mm.

Depth of body 4½ to 5¼ in the length, length of head 3¼ to 3⅔. Snout about as long as eye, diameter of which is 3¾ to 4⅓ (in specimens of 120–190 mm.) or 3½ to 4 (in specimens of 70–120 mm.) in length of head; interorbital width 6 to 8. Jaws about equal anteriorly; maxillary extending to below anterior ¼ of eye; teeth in bands, those of the outer row somewhat enlarged anteriorly; upper surface of head (except snout and praeorbital), cheeks and opercles covered with smooth scales; scales generally absent across the occiput as in the preceding species, but sometimes covering this region in larger specimens; 19 to 23 gill-rakers on lower part of anterior arch. Scales on body ctenoid; 63 to 75 in a lateral longitudinal series; 45 to 49 tubular scales in upper lateral line, which ends 2 to 4 scales in front of caudal, 4 to 10 in lower lateral line. Dorsal V (occasionally IV) 34–37; longest spine not more than $\frac{2}{5}$ length of head; posterior rays of dorsal and anal not overlapping the caudal when laid back. Anal 32–35. Pectoral $\frac{3}{5}$ to $\frac{2}{3}$ length of head, as long as or rather longer than pelvics, which do not usually reach the anal. Caudal rounded; caudal peduncle $\frac{3}{5}$ to $\frac{3}{4}$ as long as deep, its least depth less than $\frac{1}{3}$ length of head. Brownish or greyish-brown, with somewhat irregular darker cross-bars on upper parts of sides, extending on to base of soft dorsal; median fins more or less dusky, the soft dorsal, caudal, and sometimes the anal with narrow pale margins; anal generally darker, often blackish; pectorals yellowish; pelvics more or less dusky.

*Hab.* Patagonian-Falklands region: in deeper water.

This species, which is well distinguished from the shallow-water *N. brevicauda*, is named after Mr E. R. Gunther of the 'Discovery' Expedition.

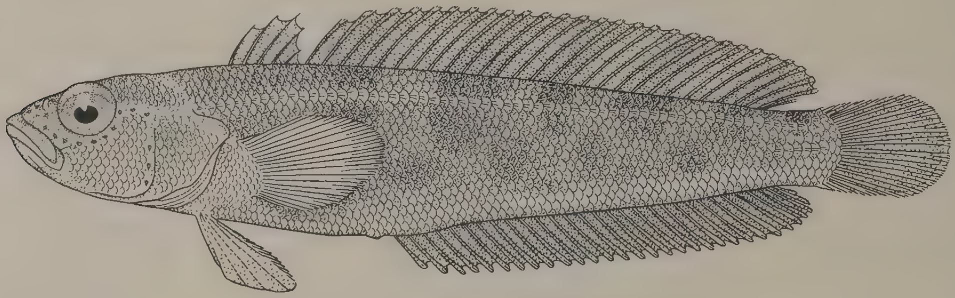

Fig. 35. *Notothenia guntheri.* Holotype. × $\frac{3}{4}$.

Mr E. R. Gunther notes that in life the body is pale slaty grey, darker on back and becoming white ventrally, the general shade never being as deep as in *N. ramsayi.* The cross-bars, if present, are faint, and are sometimes green instead of grey. There are three or four golden green bands on the side of the head, the first sloping downwards from the maxillary, the others radiating from the praeorbital and eye, the third dilating into a green flush on the angle of the operculum. The iris is of a paler tint than that of *N. ramsayi.* The dorsal fins are bright emerald green, bordered with white, and the anal fin deep grey. The caudal fin is olive varied by lemon yellow, sometimes margined with orange, sometimes with brown and white. The pectoral is pale orange or salmon pink, sometimes lemon yellow, the base of the fin quite white. The pelvic is deep grey. The belly, which has been shaded in the sketch, should be white.

**Notothenia ramsayi**, Regan (Plate I, fig. 2).

*Notothenia ramsayi*, Regan, 1913, *Trans. R. Soc. Edinb.*, XLIX, p. 267, pl. vii, fig. 1; Thompson, 1916, *Proc. U.S. Nat. Mus.*, L, p. 443.

St. 51. 4. v. 26. Off Eddystone Rock, East Falkland Islands. Large otter trawl, 105–115 m.: 35 specimens, 60–110 mm.

St. WS 72. 5. iii. 27. 51° 07′ S, 57° 34′ W. Commercial otter trawl, 79 m.: 4 specimens, 110–135 mm.

St. WS 73. 6. iii. 27. 51° 01′ S, 58° 54′ W. Commercial otter trawl, 121 m.: 40 specimens, 55–235 mm.

St. WS 79. 13. iii. 27. 51° 01′ 30″ S, 64° 59′ 30″ W. Commercial otter trawl, 132–131 m.: 6 specimens, 280–340 mm.

St. WS 83. 24. iii. 27. 14 miles S 64° W of George Island, East Falkland Islands. Commercial otter trawl, 137–129 m.: 3 specimens, 60–220 mm.

St. WS 86. 3. iv. 27. 53° 53′ 30″ S, 60° 34′ 30″ W. Commercial otter trawl, 151–147 m.: 25 specimens, 170–295 mm.

St. WS 90. 7. iv. 27. 13 miles N 83° E of Cape Virgins Light, Argentine Republic. Commercial otter trawl, 82–81 m.: 4 specimens, 110–295 mm.

St. WS 91. 8. iv. 27. 52° 53′ 45″ S, 63° 37′ 30″ W. Commercial otter trawl, 191–205 m.: 19 specimens, 135–355 mm.

St. WS 92. 8. iv. 27. 51° 58′ 30″ S, 65° 01′ W. Commercial otter trawl, 145–143 m.: 19 specimens, 120–320 mm.

St. WS 93. 9. iv. 27. 7 miles S 80° W of Beaver Island, West Falkland Islands. Commercial otter trawl, 133–130 m.: 21 specimens, 190–330 mm.

St. WS 94. 16. iv. 27. 50° 00′ 15″ S, 64° 57′ 45″ W. Commercial otter trawl, 110–126 m.: 18 specimens, 140–280 mm.

St. WS 96. 17. iv. 27. 48° 00′ 45″ S, 64° 58′ W. Commercial otter trawl, 96 m.: 1 specimen, 320 mm.

St. WS 97. 18. iv. 27. 49° 00′ 30″ S, 61° 58′ W. Commercial otter trawl, 146–145 m.: 1 specimen, 335 mm.

St. WS 98. 18. iv. 27. 49° 54′ 15″ S, 60° 35′ 30″ W. Commercial otter trawl, 173–171 m.: 1 specimen, 240 mm.

St. WS 214. 31. v. 28. 48° 25′ S, 60° 40′ W. Net (7 mm. mesh) attached to back of trawl, 208–219 mm.: 6 specimens, 60–66 mm.

St. WS 219. 3. vi. 28. 47° 06′ S, 62° 12′ W. Net (7 mm. mesh) attached to back of trawl, 116–114 m.: 8 specimens, 60–90 mm.

St. WS 220. 3. vi. 28. 47° 56′ S, 62° 38′ W. Net (7 mm. mesh) attached to back of trawl, 108–104 m.: 3 specimens, 82–87 mm.

St. WS 222. 8. vi. 28. 48° 23′ S, 65° 00′ W. Nets attached to back of trawl, 100–106 m.: 18 specimens, 60–100 mm.

St. WS 246. 19. vii. 28. 52° 25′ S, 61° 00′ W. Commercial otter trawl, 267–208 m.: 4 specimens, 285–305 mm.

St. 652. 14. iii. 31. Burdwood Bank, 54° 04′ S, 61° 40′ W. Large otter trawl, 171–169 m.: 4 specimens, 110–180 mm.

St. WS 750. 19. ix. 31. 52° 12′ S, 67° 19′ W. Rectangular net, 95 m.: 1 specimen, 205 mm.

St. WS 754. 20. ix. 31. 51° 09′ 30″ S, 58° 54′ W. Rectangular net, 111 m.: 1 specimen, 70 mm.

St. WS 756. 10. x. 31. 50° 54′ 39″ S, 59° 58′ W. Commercial otter trawl, with net (7 mm. mesh) and seine net attached to back of trawl, 118–90 m.: 14 specimens, 60–110 mm.

St. WS 764. 17. x. 31. 44° 38′ 15″ to 44° 38′ 45″ S, 61° 58′ 30″ to 61° 49′ 30″ W. Commercial otter trawl, 110–104 m.: 50 specimens, 75–220 mm.

St. WS 771. 29. x. 31. 42° 41′ 45″ S, 60° 31′ W. Commercial otter trawl, 90 m.: 70 specimens, 70–120 mm.

St. WS 772. 30. x. 31. 45° 13′ 22″ S, 60° 00′ 15″ W. Commercial otter trawl, 309–162 m.: 2 specimens, 210, 220 mm.

St. WS 781. 6. xi. 31. 50° 30′ S, 58° 50′ W. Commercial otter trawl, 148 m.: 27 specimens, 100–325 mm.

St. WS 784. 5. xii. 31. 49° 47′ 45″ S, 61° 05′ W. Net (7 mm. mesh) and seine net attached to back of trawl, 170–164 m.: 12 specimens, 80–125 mm.

St. WS 787. 7. xii. 31. 48° 44′ S, 65° 24′ 30″ W. Nets attached to back of trawl, 106–110 m.: 30 specimens, 80–210 mm.

St. WS 788. 13. xii. 31. 45° 05′ S, 65° 00′ W. Commercial otter trawl, 82–88 m.: 1 specimen, 160 mm.

St. WS 789. 13. xii. 31. 45° 17′ S, 64° 22′ W. Seine net attached to back of trawl, 95–93 m.: 2 specimens, 155, 200 mm.

St. WS 792. 15. xii. 31. 45° 49′ 30″ S, 62° 20′ 15″ W. Nets attached to back of trawl, 102–112 m.: 48 specimens, 90–250 mm.

St. WS 795(?). 18. xii. 31. 46° 14′ S, 60° 24′ W. Commercial otter trawl, 157–161 m.: 8 specimens, 300–350 mm.

St. WS 797–805 or 811. Between 47° 45′ and 51° 27′ S, 63° 29′ and 68° 01′ W: 22 specimens, 130–325 mm.

St. WS 800. 21. xii. 31. 48° 15′ 45″ S, 62° 09′ 52″ W. Nets attached to back of trawl, 139–137 m.: 11 specimens, 110–120 mm.

St. WS 803. 5. i. 32. 50° 33′ 45″ S, 62° 05′ 30″ W. Commercial otter trawl, with net (7 mm. mesh) attached, 173–186 m.: 3 specimens, 125–215 mm.

St. WS 804. 6. i. 32. 50° 22′ 45″ S, 62° 49′ W. Commercial otter trawl, with net (7 mm. mesh) and seine net attached, 150–143 m.: 14 specimens, 110–135 mm.

St. WS 806. 7. i. 32. 50° 03′ 30″ S, 64° 21′ W. Commercial otter trawl, with net (7 mm. mesh) attached, 129–122 m.: 10 specimens, 130–350 mm.

St. WS 811. 12. i. 32. 51° 24′ 30″ S, 67° 53′ W. Commercial otter trawl, 96–98 m.: 10 specimens, 85–235 mm.

St. WS 839. 5. ii. 32. 53° 30′ 15″ S, 63° 29′ W. Commercial otter trawl, 403–434 m.: 1 specimen, 230 mm.

St. WS 841. 6. ii. 32. 54° 11′ 45″ S, 60° 21′ 30″ W. Net (7 mm. mesh) attached to back of trawl, 110–120 m.: 1 specimen, 235 mm.

St. WS 844. 7–8. ii. 32. 52° 14′ S, 64° 10′ W. Rectangular net, 217 (–0) m.: 1 specimen, 270 mm.

St. WS 864. 28. iii. 32. 49° 33′ 30″ S, 64° 16′ W. Nets attached to back of trawl, 128–126 m.: 73 specimens, 45–70 mm.

St. WS 868. 30. iii. 32. 51° 44′ S, 64° 13′ W. Commercial otter trawl, 166–162 m.: 35 specimens, 140–340 mm.

St. WS 869. 31. iii. 32. 52° 15′ 30″ S, 64° 13′ 45″ W. Rectangular net, 187 (–0) m.: 1 specimen, 60 mm.

St. WS 874. 3. iv. 32. 52° 35′ 30″ S, 65° 14′ W. Rectangular net, 135–132 m.: 1 specimen, 235 mm.

St. WS 878. 4. iv. 32. 52° 36′ S, 58° 54′ W. Rectangular net, 121 (–0) m.: 1 specimen, 150 mm.

Depth of body 4 to $5\frac{1}{2}$ in the length, length of head 3 to $3\frac{3}{5}$. Snout as long as or a little longer than eye (shorter in young), diameter of which is 3 (young) to nearly 5 in length of head; interorbital width $4\frac{1}{5}$ to nearly $6\frac{1}{4}$. Jaws about equal anteriorly; maxillary extending to below anterior $\frac{1}{4}$ (occasionally anterior $\frac{1}{3}$) of eye; teeth in bands, those of outer row somewhat enlarged anteriorly; upper surface of head (except snout and praeorbital), cheeks and opercles scaled; scales on upper surface of head extending forward to level of nostrils, generally more or less ctenoid, except in large examples, in which they may be quite smooth; 6 to 8 rows of scales between the eyes (fewer in young); 16 to 25 gill-rakers on lower part of anterior arch. Scales on body more or less ctenoid; 60 to 72 in a lateral longitudinal series; 46 to 54 tubular scales in upper lateral line, which nearly reaches the caudal, 8 to 18 in lower lateral line. Dorsal VI (very occasionally V)–VIII (generally VII) 34–37; longest spine $\frac{1}{3}$ to a little more than $\frac{2}{5}$ length of head. Anal 31–35. Pectoral from less than $\frac{3}{5}$ to more than $\frac{2}{3}$ length of head, usually rather longer than pelvics, which extend to vent or not as far and occasionally reach the anal fin. Caudal rounded; caudal peduncle $\frac{2}{3}$ to $\frac{4}{5}$ as long as deep, its least depth $\frac{1}{4}$ to $\frac{2}{7}$ length of head. Pale brownish, with a lateral series of 5 to 7 dark blotches or vertical bars; both dorsal fins dusky, the spinous dorsal paler at its base, the rays of the soft dorsal tipped with white; anal and caudal pale or more or less dusky, both fins narrowly margined with white; pectoral pale, usually with a dark vertical bar across the base.

*Hab.* Patagonian-Falklands region.

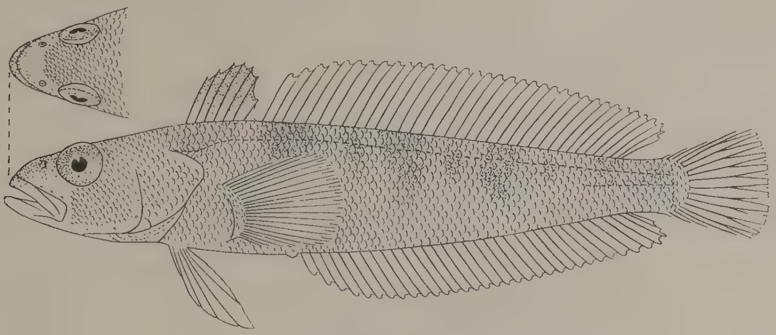

Fig. 36. *Notothenia ramsayi.* × $\frac{2}{5}$.

In addition to the many specimens listed above, there are 6 more (205–330 mm.) in the British Museum collection, from the Burdwood Bank—the types of the species.[1]

This was the commonest species of *Notothenia* taken during the Trawling Surveys, and occurred at depths ranging from 82 to 434 metres. It does not seem to inhabit very shallow water, however, and in this respect bears much the same relationship to *N. wiltoni* as does *N. guntheri* to *N. brevicauda.*

*Numbers of gill-rakers in* N. wiltoni *and* N. ramsayi.

| *N. wiltoni* | Gill-rakers | *N. ramsayi* |
|---:|:---:|:---|
| | 13 | |
| . | 14 | |
| . . . . . | 15 | |
| . . . . . . . . . . . . . . | 16 | . . . . . . |
| . . . . . . . . . . . . . . . . . . . . | 17 | . . . . . . . . . . . . |
| . . . . . . . . . . . . . . . | 18 | . . . . . . . . . . . . . . . . . . . . . . |
| . . . | 19 | . . . . . . . . . . . . . . . . . . . . . . |
| | 20 | . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . |
| | 21 | . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . |
| | 22 | . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . |
| | 23 | . . . . . . . . . . . . . . . . . . . . . . . . . . . |
| | 24 | . . . . . . . . . . . . |
| | 25 | . . . . |
| | 26 | . |
| | 27 | |

Mr E. R. Gunther notes that in life this species has the body grey, tinged with olive, darker on back and becoming white ventrally. The dark cross-bars are sometimes interspersed with pale silvery blue. The cheek is slightly silvery, the opercles more so with a green and blue lustre; a red flush is sometimes present on upper margin of cheek. The colour of the iris is brazen. The dorsal fins are dusky, with vertical bars of auburn, and are often margined with white. The anal fin is grey, the free distal parts of the rays white. The caudal is olive. The pectoral is olive, usually pale, the base of the fin with a vertical bar of dark pigment. The pelvic is white or dusky. The belly, which is shaded in the sketch, should be white.

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[1] The specimen from Isthmus Bay, Magellan Straits, identified by Regan as this species, is in poor condition, but probably belongs to *N. wiltoni.*

**Notothenia wiltoni, Regan.**[1]

*Notothenia tessellata* (part), Günther, 1881, *Proc. Zool. Soc.*, p. 20.

*Notothenia longipes* (*non* Steindachner), Günther, 1881, *t.c.*, p. 20; Vaillant, 1888, *Miss. Sci. Cap Horn*, VI. Zool., Poiss., p. 25; Jordan, 1891, *Proc. U.S. Nat. Mus.*, XIII, p. 335; Lönnberg, 1905, *Wiss. Ergebn. Schwed. Südpol.-Exped.*, V (6), p. 15; Thompson, 1916, *Proc. U.S. Nat. Mus.*, L, p. 451; Devincenzi, 1924, *Anal. Mus. Montevideo* (II) I (5), p. 267.

? *Notothenia squamifrons*, Vaillant, 1888, *Miss. Sci. Cap Horn*, VI. Zool., Poiss., p. 24.

*Notothenia wiltoni*, Regan, 1913, *Trans. Roy. Soc. Edinb.*, XLIX, p. 268, pl. vii, fig. 2.

St. 55. 16. v. 26. Entrance to Port Stanley, East Falkland Islands, 2 cables S 24° E of Navy Point. Small beam trawl, 10–16 m.: 1 specimen, 105 mm.

St. 56. 16. v. 26. Sparrow Cove, Port William, East Falkland Islands, $1\frac{1}{2}$ cables N 50° E of Sparrow Point. Small beam trawl, $10\frac{1}{2}$–16 m.: 2 specimens, 100, 110 mm.

St. 222. 22–24. iv. 27. St Martin's Cove, Hermite Island, Cape Horn. Large fish-trap, 30–35 m.: 1 specimen, 225 mm.

4. v. 31. Field Anchorage, Magellan Straits. Hand line, 26 m.: 1 specimen, 210 mm.

Depth of body $4\frac{1}{2}$ to 5 in the length, length of head 3 to $3\frac{1}{3}$. Snout as long as or a little longer than eye, diameter of which is 4 to 5 in length of head; interorbital width $5\frac{4}{5}$ to $7\frac{1}{3}$. Lower jaw a little longer than the upper; maxillary extending to below anterior $\frac{1}{3}$ of eye or beyond (occasionally to below anterior $\frac{1}{4}$); teeth in bands, those of outer row somewhat enlarged anteriorly; upper surface of head (except snout and praeorbital), cheeks and opercles scaled; scales on upper surface of head all smooth, 5 or 6 rows between the eyes; (14) 15 to 19 gill-rakers on lower part of anterior arch. Scales on body more or less ctenoid; 62 to 75 in a lateral longitudinal series; 48 to 53 tubular scales in upper lateral line, which nearly reaches caudal, 6 to 13 in lower lateral line. Dorsal VI (occasionally VII) 34–36; longest spine not more than $\frac{1}{3}$ length of head. Anal 32–34. Pectoral $\frac{3}{5}$ to $\frac{2}{3}$ length of head, longer than pelvics, which extend just to the vent or not as far (in adults). Caudal rounded; caudal peduncle $\frac{3}{5}$ to $\frac{2}{3}$ as long as deep, its least depth $\frac{1}{4}$ to $\frac{2}{7}$ length of head. Dark greyish brown, with traces of indistinct darker cross-bars; dorsals, anal and caudal dusky, generally narrowly margined with white; pectoral pale, with a dark vertical bar across the base; pelvics more or less dusky.

*Hab.* Coasts of Argentina and eastern Patagonia; Straits of Magellan; Tierra del Fuego; Falkland Islands.

In addition to the above, Mr Bennett has sent 45 specimens (135–340 mm.) from Stanley, Falkland Islands, taken by hook or trap in 1 to $1\frac{1}{2}$ fathoms, or under stones at low water, in November, December, and January. There are also 7 specimens

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[1] This species has been so often confused with *N. longipes* that it has proved impossible to give satisfactory full synonymies of these two forms.

(125–250 mm.) in the British Museum collection from the Falklands, Orange Bay, Isthmus Bay, Latitude Bay, and Sandy Point, including the types of the species and 2 specimens identified by Thompson as *N. longipes*, received from the United States National Museum.

This species appears to inhabit shallower water than the closely related *N. ramsayi*, from which it may be distinguished by the smooth scales on the upper surface of the head, rather larger mouth and smaller eye, narrower interorbital region, smaller average number of gill-rakers, lower spinous dorsal fin, and generally darker colour. Mr Bennett notes that *N. wiltoni* is very common at certain seasons at the Falkland Islands, where it is known as "Rock Cod", a name also used for other species of *Notothenia*. According to him this fish seems to come to the shore in November at Stanley, and to leave at about the middle of April. As specimens taken in April showed enlarged reproductive organs, Mr Bennett assumes that the departure from Stanley is for breeding purposes. In the Falklands this species is found round jetties and in the "kelp", lurking under shelter during the day and becoming active about sunset.

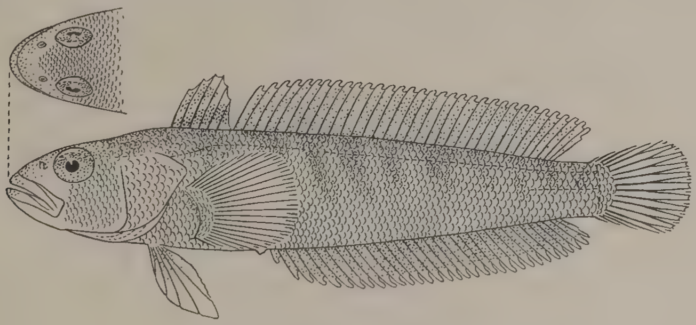

Fig. 37. *Notothenia wiltoni*. × $\frac{2}{5}$.

**Notothenia longipes**, Steindachner.

*Notothenia longipes*, Steindachner, 1876, *SitzBer. Akad. Wiss. Wien*, LXXII (1), p. 70, pl. vi (right-hand fig.); Günther, 1880, *Shore Fish. 'Challenger'*, p. 21; Steindachner, 1898, *Zool. Jahrb.*, Suppl. IV, p. 304; Steindachner, 1903, *Zool. Jahrb.*, Suppl. VI, p. 207; Regan, 1913, *Trans. R. Soc. Edinb.*, XLIX, p. 269.

? *Notothenia tessellata* forma *megalops*, Smitt, 1897, *Bih. Sv. Vet.-Akad. Handl.*, XXIII, IV, No. 3, p. 25, pl. i, figs. 1–6, pl. ii, figs. 18, 19.

St. WS 582. 1. v. 31. 53° 42′ 30″ S, 70° 55′ W. Hand line, 12 m.: 1 specimen, 160 mm.

St. WS 583. 2. v. 31. 53° 39′ S, 70° 54′ 30″ W. Small beam trawl, 14–78 m.: 20 specimens, 55–125 mm.

7. v. 31. Ringdove Inlet, Wide Channel. Hand line: 1 specimen, 170 mm.

Depth of body $5\frac{1}{4}$ to $6\frac{1}{2}$ in the length, length of head $3\frac{1}{3}$ to $3\frac{2}{3}$. Snout shorter than eye, diameter of which is 3 to $3\frac{3}{5}$ in length of head; interorbital width 7 to 8. Jaws about equal anteriorly; maxillary extending to below anterior $\frac{1}{4}$ of eye; teeth in bands, those of outer row a little enlarged anteriorly; upper surface of head (except snout and praeorbital), cheeks and opercles covered with smooth scales; about 5 rows of scales between the eyes; 14 to 16 gill-rakers on lower part of anterior arch. Scales on body more or less ctenoid; 62 to 70 in a lateral longitudinal series; 46 to 55 tubular scales in upper lateral line, which nearly reaches the caudal, 6 to 13 in lower lateral line. Dorsal VI[1] 34–37; longest spine $\frac{1}{3}$ to $\frac{2}{5}$ length of head. Anal 32–34. Pectoral $\frac{3}{5}$ to $\frac{2}{3}$ length of head, as long as or rather shorter than pelvics, which reach the anal. Caudal rounded; caudal peduncle as long as deep or rather deeper than long, its least depth $\frac{1}{4}$ to $\frac{2}{7}$ length of head. Body with irregular darker cross-bars, which may extend on to the base of the soft dorsal; spinous dorsal dusky, paler at base; soft dorsal, caudal and anal margined with white; pectoral pale, with a dark vertical bar across the base; pelvics yellowish.

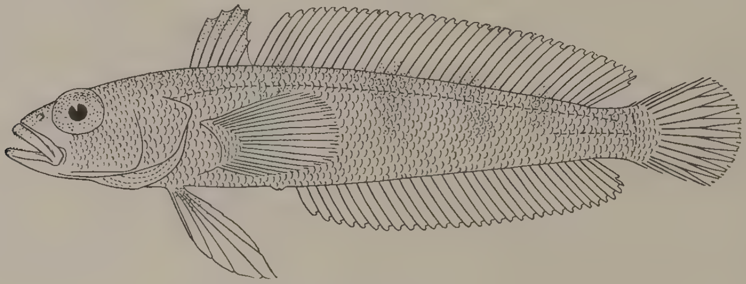

Fig. 38. *Notothenia longipes.* $\times \frac{2}{3}$.

*Hab.* Straits of Magellan; west coast of Patagonia.

In addition to the above, there are 4 specimens (130–180 mm.) in the British Museum collection from Port Famine and the Messier Channel. This species is difficult to distinguish from *N. wiltoni*, especially in the younger stages, and it is possible that the two forms may eventually prove to be identical. *N. longipes* has a rather more slender body, larger eye, and somewhat longer pelvic fins.

**Notothenia squamiceps, Peters.**

*Notothenia squamiceps*, Peters, 1876, *Monatsber. Akad. Berlin*, p. 387; Thompson, 1916, *Proc. U.S. Nat. Mus.*, L, p. 441, pl. iii, fig. 2.

? *Notothenia cornucola* (part), Smitt, 1897, *Bih. Sv. Vet.-Akad. Handl.*, XXIII, IV, No. 3, p. 12.

*Notothenia sima*, Lönnberg, *Wiss. Ergebn. Schwed. Südpol.-Exped.*, V (6), p. 12, pl. i, fig. 1.

St. 53. 12. v. 26. Port Stanley, East Falkland Islands. Hulk of 'Great Britain'. Mussel rake, 0–2 m.: 3 specimens, 80–120 mm.[2]

St. 55. 16. v. 26. Entrance to Port Stanley, East Falkland Islands, 2 cables S 24° E of Navy Point. Small beam trawl, 10–16 m.: 1 specimen, 90 mm.

St. 56. 16. v. 26. Sparrow Cove, Port William, East Falkland Islands, $1\frac{1}{2}$ cables N 50° E of Sparrow Point. Small beam trawl, $10\frac{1}{2}$–16 m.: 3 specimens, 85–95 mm.

Head more or less compressed. Depth of body $3\frac{2}{3}$ to 4 in the length, length of head $3\frac{1}{4}$ to $3\frac{3}{5}$. Snout as long as or rather longer than eye, diameter of which is $4\frac{1}{4}$ to nearly 5 in length of head; interorbital width $3\frac{3}{4}$ to $4\frac{1}{2}$ (narrower in young). Jaws about equal anteriorly; maxillary extending to below anterior $\frac{1}{4}$ or anterior $\frac{1}{3}$ of eye; teeth in bands, those of the outer row a little enlarged anteriorly; occiput, interorbital region, cheeks and opercles with smooth scales, those between the eyes as large or nearly as large as those on sides of body and on operculum; scales not embedded, extending forward on upper surface of head to opposite middle or anterior parts of eyes; 13 to 16 gill-rakers on lower part of anterior arch. Scales on body ctenoid; 46 to 50 in a lateral longitudinal series; 37 to 40 tubular scales in upper lateral line, which ends below or a little in advance of last ray of dorsal, 7 to 11 in lower lateral line. Dorsal VI–VII (VIII in one example) 27–30; longest spine about $\frac{1}{3}$ length of head. Anal 29–31. Pectoral $\frac{2}{3}$ to $\frac{3}{4}$ length of head, a little longer than pelvics, which extend to the origin of anal or beyond. Caudal rounded; caudal peduncle $\frac{3}{5}$ to $\frac{2}{3}$ as long as deep, its least depth $\frac{2}{7}$ to $\frac{1}{3}$ length of head. Brownish; uniform or with indistinct darker cross-bars on upper parts of body; often some round pale spots on back and sides; spinous dorsal more or less dusky, plain or with a round dark spot posteriorly; sometimes the greater part of the fin is dark, with a clear area posteriorly; soft dorsal uniform or with broad dark areas separated by narrower clear interspaces; caudal sometimes with dark cross-bars; anal uniform or coloured like the soft dorsal; pectoral yellowish; pelvics partly blackish.

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[1] I count 6 spines in all the specimens in the British Museum.

[2] With these specimens is a mass of eggs.

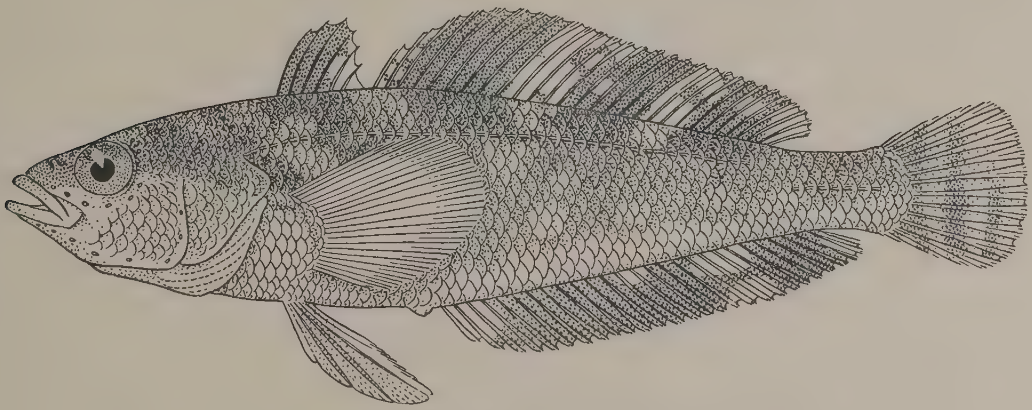

Fig. 39. *Notothenia squamiceps.* × 1½.

*Hab.* Patagonia and the Straits of Magellan; Falkland Islands.

In addition to the above, the British Museum has received a small specimen, 45 mm. in total length, from Port Churruca, Magellan, as an exchange from the United States National Museum (U.S.N.M. No. 76883). There seems to be little doubt that Thompson was correct in separating this species from the closely related *N. sima*, and I feel fairly certain that his specimens, as well as those collected by the 'Discovery' Expedition, are referable to Peters' species, which was not previously represented in the British Museum collection. *N. squamiceps* differs from *N. sima* chiefly in having a deeper body, wider interorbital region with larger scales between the eyes, more numerous gill-rakers, and a different coloration.

**Notothenia sima, Richardson.** "Ouchounaya."

*Notothenia sima*, Richardson, 1845, *Zool. 'Erebus' and 'Terror'*, Fishes, p. 19, pl. xi, figs. 1, 2; Günther, 1860, *Cat. Fish.*, II, p. 262; Vaillant, 1888, *Miss. Sci. Cap Horn*, VI. Zool., Poiss., p. 25; Steindachner, 1898, *Zool. Jahrb.*, Suppl. IV, p. 303; Boulenger, 1900, *Ann. Mag. Nat. Hist.* (7) VI, p. 53; Boulenger, 1902, '*Southern Cross*', *Pisces*, p. 183; Lönnberg, 1907, *Hamb. Magalh. Sammelr.*, Fische, p. 9; Regan, 1913, *Trans. R. Soc. Edinb.*, XLIX, pp. 240, 269; Thompson, 1916, *Proc. U.S. Nat. Mus.*, L, p. 439.

*Notothenia cornucola* (part), Smitt, 1897, *Bih. Sv. Vet.-Akad. Handl.*, XXIII, IV, No. 3, p. 12.

*Notothenia karlandreae*, Lönnberg, 1905, *Wiss. Ergebn. Schwed. Südpol.-Exped.*, V (6), p. 14, pl. iv, fig. 13.

St. 55. 16. v. 26. Entrance to Port Stanley, East Falkland Islands, 2 cables S 24° E of Navy Point. Small beam trawl, 10–16 m.: 2 specimens, 100, 105 mm.

St. 56. 16. v. 26. Sparrow Cove, Port William, East Falkland Islands, $1\frac{1}{2}$ cables N 50° E of Sparrow Point. Small beam trawl, $10\frac{1}{2}$–16 m.: 1 specimen, 80 mm.

Head not compressed. Depth of body 4 to 5 in the length, length of head $3\frac{1}{4}$ to $3\frac{2}{3}$. Snout as long as or rather longer than eye, diameter of which is 4 to 6 in length of head; interorbital width $5\frac{1}{2}$ to nearly 8. Jaws about equal anteriorly or lower a little longer; maxillary extending to below anterior part or middle of eye; teeth in two or three irregular rows, at least anteriorly; sometimes nearly uniserial; teeth of the outer row somewhat enlarged anteriorly; occiput, interorbital region, cheeks and opercles with smooth scales, but those on upper surface of head, and particularly in the interorbital region, often reduced in number and more or less deeply embedded in the skin; scales on upper surface of head much smaller than those on sides of body and on the operculum; 9 to 12 gill-rakers on lower part of anterior arch. Scales on body ctenoid; 40 to 47 in a lateral longitudinal series; 30 to 36 tubular scales in upper lateral line, which ends well in advance of last ray of dorsal, 2 to 12 in lower lateral line. Dorsal VI (rarely V) 27–31; longest spine $\frac{1}{3}$ to $\frac{2}{5}$ length of head. Anal 27–30. Pectoral $\frac{2}{3}$ to $\frac{3}{4}$ length of head, a little longer than pelvics, which extend to the vent or occasionally to the anal fin. Caudal rounded; caudal peduncle not more than $\frac{1}{2}$ as long as deep, its least depth about $\frac{1}{3}$ length of head. Head with some indistinct darker markings; body with irregular dark cross-bars; spinous dorsal mostly covered by a blackish blotch; soft dorsal more or less dusky, except sometimes at base, and with a narrow white margin; anal similar or with more or less prominent oblique stripes;

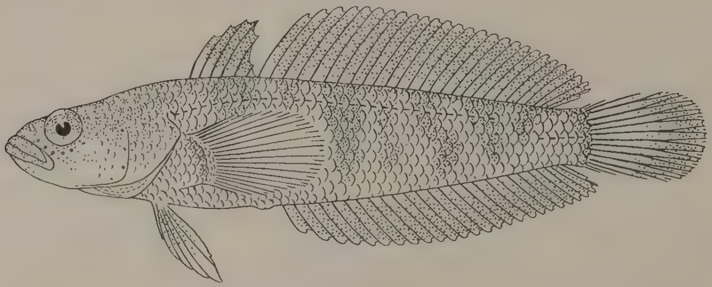

Fig. 40. *Notothenia sima*. ×1.

caudal plain or with darker cross-bars, nearly always with dark markings at its base; pectoral and pelvics plain or more or less tinged with dusky, the former generally with a dark bar across the base.

*Hab.* Patagonia and the Straits of Magellan; Falkland Islands.

In addition to the above, Mr Bennett has sent many specimens (40–140 mm.) from Stanley Harbour and the Dockyard Jetty, Falkland Islands, taken either in a trap set in $1\frac{1}{2}$ fathoms or in a seine net operated from the shore, in February and November. There are also 24 specimens (60–120 mm.) in the British Museum collection, from the Falklands, Orange Bay and Magellan, including the type of the species and a co-type of *Notothenia karlandreae*.

This species exhibits a remarkable degree of variation in the scaling of the head, but may be readily distinguished from *N. cornucola*, which it closely resembles in appearance, not only by the fully scaled operculum, but also by the number of dorsal spines and number of rays in the soft dorsal, the somewhat larger scales, the narrower and flatter interorbital region, etc. It is said to be very common in the Falkland Islands, and a specimen sent to the British Museum by the late Mr R. Vallentin, taken by him in November, 1909, was found coiled round a bunch of eggs at low tide. Others taken near the end of September also had ripe ova, so that the breeding season would appear to be at a different time to that of *N. squamiceps*.

**Notothenia cornucola**, Richardson. "Oumouch."

*Notothenia cornucola*, Richardson, 1845, *Zool. 'Erebus' and 'Terror'*, Fishes, pp. 8, 18, pl. viii, figs. 4, 5, pl. xi, figs. 3, 4; Günther, 1860, *Cat. Fish.*, II, p. 261; Cunningham, *Trans. Linn. Soc. London*, XXVII, p. 470; Steindachner, 1876, *SitzBer. Akad. Wiss. Wien*, LXXII (1), p. 73; Peters, 1876, *Monatsber. Akad. Berlin*, p. 836; Günther, 1881, *Proc. Zool. Soc.*, p. 20; Vaillant, 1888, *Miss. Sci. Cap Horn*, VI. Zool., Poiss., p. 25; Perugia, 1891, *Ann. Mus. Civ. stor. nat. Genova* (2) x [xxx], p. 619; Steindachner, 1898, *Zool. Jahrb.*, Suppl. IV, p. 301; Regan, 1913, *Trans. R. Soc. Edinb.*, XLIX, pp. 240, 275; Thompson, 1916, *Proc. U.S. Nat. Mus.*, L, p. 436.

*Notothenia virgata*, Richardson, 1845, *t.c.*, p. 18, pl. xi, figs. 5, 6; Günther, 1860, *Cat. Fish.*, II, p. 262.

*Notothenia marginata*, Richardson, 1845, *t.c.*, p. 18, pl. xii, figs. 1, 2.

*Notothenia cornucola* var. *virgata*, Vaillant, 1888, *Miss. Sci. Cap Horn*, VI. Zool., Poiss., p. 25.

*Notothenia cornucola* var. *marginata*, Vaillant, 1888, *t.c.*, p. 26.

*Notothenia cornucola* (part), Smitt, 1897, *Bih. Sv. Vet.-Akad. Handl.*, XXIII, IV, No. 3, p. 12; Delfin, 1901, *Cat. Peces Chile*, p. 85.

*Notothenia modesta*, Steindachner, 1898, *Zool. Jahrb.*, Suppl. IV, p. 302, pl. xx, fig. 3.

*Notothenia coriiceps*, Steindachner, 1903, *Zool. Jahrb.*, Suppl. VI, p. 207; Dollo, 1904, *Rés. Voy. 'Belgica'*, Poiss., p. 79; Lönnberg, 1905, *Wiss. Ergebn. Schwed. Südpol.-Exped.*, V (6), pp. 6, 13; Lönnberg, 1907, *Hamb. Magalh., Sammelr.*, Fische, p. 9; Hussakof, 1914, *Bull. Amer. Mus. Nat. Hist.*, XXXIII, p. 89.

St. 52. 5. v. 26. Port William, East Falkland Islands, 7·4 cables N 17° E of Navy Point. Hand line, 17 m.: 1 specimen, 65 mm.

St. 53. 12. v. 26. Port Stanley, East Falkland Islands. Hulk of 'Great Britain'. Mussel rake, 0–2 m.: 1 specimen, 90 mm.

St. 55. 16. v. 26. Entrance to Port Stanley, East Falkland Islands, 2 cables S 24° E of Navy Point. Small beam trawl, 10–16 m.: 1 specimen, 58 mm.

St. 56. 16. v. 26. Sparrow Cove, Port William, East Falkland Islands, 1½ cables N 50° E of Sparrow Point. Small beam trawl, 10½–16 m.: 1 specimen, 65 mm.

St. 222. 22–24. iv. 27. St Martin's Cove, Hermite Island, Cape Horn. Large rectangular net, 30–35 m.: 1 specimen, 74 mm.

Depth of body 3⅔ to 4½ in the length, length of head 3 to 3⅔. Snout as long as or a little longer than eye, diameter of which is 3¾ (young) to 6 in length of head; interorbital width 4⅔ to 6. Jaws equal anteriorly; maxillary extending to below anterior part or middle of eye; teeth in 2 to 4 rows in each jaw, at least anteriorly; sometimes uniserial; teeth of the outer row somewhat enlarged anteriorly; usually a few scales behind eye and on upper part of operculum; upper surface of head quite naked; scales between occiput and dorsal fin very small and embedded in the skin; 11 or 12 gill-rakers on lower part of anterior arch. Scales on body ctenoid; 47 to 55 in a lateral longitudinal series; 36 to 42 tubular scales in upper lateral line, which ends below last ray or last 2 or 3 rays of dorsal, 4 to 12 in lower lateral line. Dorsal IV–VI (nearly always V) 31–34; longest spine ⅓ to ⅖ length of head. Anal 27–31. Pectoral about ⅔ length of head, as long as or a little longer than pelvics, which extend to vent or not as far. Caudal rounded; caudal peduncle much deeper than long. Coloration usually rather dark, the body being spotted or marbled with darker, sometimes with irregular cross-bars; sometimes a broad, yellowish-white lateral band, which is more distinct on posterior part of body; cheek with two oblique pale stripes separated by a narrow dark streak, the upper running backwards from the praeorbital, the lower from the mouth; a dark blotch or bar above these stripes, covering the hinder part of the cheek; spinous dorsal with a black blotch; soft dorsal and anal usually dusky, but in the young these fins are paler, and spotted and streaked with brown, or with oblique stripes; both fins with narrow pale margins; caudal with dark cross-bars, becoming indistinct in adults, and with a pale hinder margin; pectorals pale or somewhat dusky, a dark vertical bar across the base; pelvics dusky.

*Hab.* Patagonia; Falkland Islands; Straits of Magellan; southern Chile, northwards to Chiloe; New Zealand(?).[1]

In addition to the above, Mr Bennett has sent several specimens (35–125 mm.) from Stanley, Falkland Islands, mostly taken under stones between tides or from the "kelp" in March, April, July and November; as well as 6 others (105–130 mm.), collected near the beach at New Island, West Falklands, by Mr Hamilton in February, 1934. There are also 25 specimens (90–140 mm.) in the British Museum collection, from the

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[1] The evidence for the occurrence of this species in New Zealand is very slender. There is a single small specimen (60 mm. long) in the British Museum collection labelled "New Zealand. Dr Richardson", but there appears to be no record of such a fish in Richardson's works. The registered number of the specimen is 60.3.19.66, and reference to the original register merely shows that it formed part of a large collection received from India House. I am of the opinion that the locality given is an error. In his Catalogue of the Fishes of New Zealand (1872), Hutton remarks that he did not see any specimens of *N. cornucola*, and he apparently includes this species on the authority of Günther. In 1873 (*Trans. N. Zealand Inst.*, v, p. 262) the same author says that specimens of *N. cornucola* "were brought by Mr Henry Travers from the Chatham Islands, and I also saw it last January in Dunedin". From his brief notes, it seems probable that he had examples of *N. macrocephala*, Günther.

Falklands and the Straits of Magellan, including the types of the species and the types of *N. virgata* and *N. marginata.*

Hussakof records an example collected on 25 May, 1899, which was greatly distended with eggs, and Lönnberg mentions a ripe female caught in the month of September. Assuming that these identifications were correct, this species would seem to have an extended breeding season.

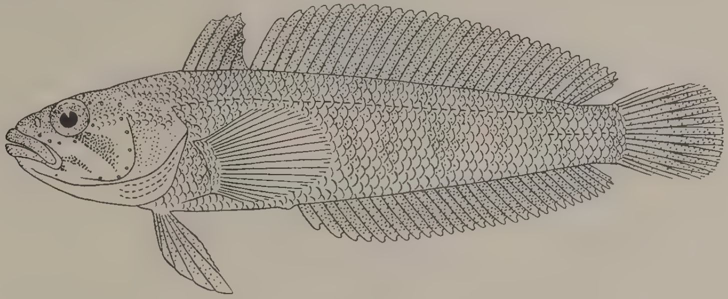

Fig. 41. *Notothenia cornucola.* × 1.

**Notothenia elegans,** Günther.

*Notothenia elegans*, Günther, 1880, *Shore Fish. 'Challenger'*, p. 21, pl. xi, fig. C; Perugia, 1891, *Ann. Mus. Civ. stor. nat. Genova* (2) x [xxx], p. 619; Delfin, 1901, *Cat. Peces Chile*, p. 87; Regan, 1913, *Trans. R. Soc. Edinb.*, XLIX, p. 274; Thompson, 1916, *Proc. U.S. Nat. Mus.*, L, p. 435.

St. 51. 4. v. 26. Off Eddystone Rock, East Falkland Islands. Large otter trawl, 105–115 m.: 4 specimens, 80–95 mm.

St. WS 93. 9. iv. 27. 7 miles S 80° W of Beaver Island, West Falkland Islands. Commercial otter trawl, 133–130 m.: 1 specimen, 75 mm.

St. WS 237. 7. vii. 28. 46° 00′ S, 60° 05′ W. Net (7 mm. mesh) attached to back of trawl, 150–256 m.: 1 specimen, 55 mm.

St. WS 767. 19. x. 31. 45° 12′ S, 61° 41′ W. Rectangular net, 98 m.: 4 specimens, 55–75 mm.

St. WS 795. 18. xii. 31. 46° 14′ S, 60° 24′ W. Net (7 mm. mesh) attached to back of trawl, 157–161 m.: 1 specimen, 75 mm.

St. WS 808. 8. i. 32. 49° 40′ 15″ S, 65° 42′ W. Seine net attached to back of trawl, 109–107 m.: 3 specimens, 28–53 mm.

St. WS 836. 3. ii. 32. 53° 05′ 30″ S, 67° 38′ W. Small beam trawl, 64 m.: 6 specimens, 69–103 mm.

St. WS 861. 27. iii. 32. 47° 40′ S, 64° 12′ W. Small beam trawl, 117–124 m.: 1 specimen, 40 mm.

St. WS 863. 28. iii. 32. 49° 05′ S, 64° 09′ W. Small beam trawl, 121–117 m.: 22 specimens, 35–120 mm.

St. WS 867. 30. iii. 32. 51° 10′ S, 64° 15′ 30″ W. Small beam trawl, 150–147 m.: 1 specimen, 80 mm.

St. WS 873. 2. iv. 32. 52° 35′ S, 67° 19′ W. Rectangular net, 93 (–0) m.: 1 specimen, 120 mm.

St. WS 878. 4. iv. 32. 52° 36′ S, 58° 54′ W. Rectangular net, 121 (–0) m.: 11 specimens, 60–90 mm.

Depth of body 6 to 7 in the length, length of head $3\frac{3}{4}$ to $4\frac{1}{4}$. Snout shorter than eye, diameter of which is $3\frac{1}{4}$ to $3\frac{3}{4}$ in length of head; interorbital width 10 to 13. Jaws about equal anteriorly; maxillary extending to below anterior part of eye; teeth in bands in both jaws, those of the outer row a little enlarged anteriorly; a few scales behind the eye and on the upper part of the operculum; head otherwise naked; 8 to 11 gill-rakers on lower part of anterior arch. Scales on body ctenoid; 46 to 50 in a lateral longitudinal series; 39 to 41 tubular scales in upper lateral line, which ends below or in advance of last ray of dorsal, 4 to 11 in lower lateral line. Dorsal VI 31–33; longest spine $\frac{2}{5}$ to $\frac{2}{3}$ length of head. Anal 30–32. Pectoral $\frac{3}{4}$ to $\frac{7}{8}$ length of head, as long as or a little shorter than pelvics, which extend to vent or beyond. Caudal rounded; caudal peduncle somewhat deeper than long. Sides of body with large dark spots or irregular cross-bars; usually a narrow pale streak running along side below the lateral line; a pale oblique stripe, bordered with darker, sometimes present on the head; mucous pores on head often black; spinous dorsal pinkish at its extremity; soft dorsal with series of small dark spots, sometimes united to form longitudinal stripes; caudal with 2 or 3 indistinct cross-bars; anal, pectoral and pelvics uniformly pale.

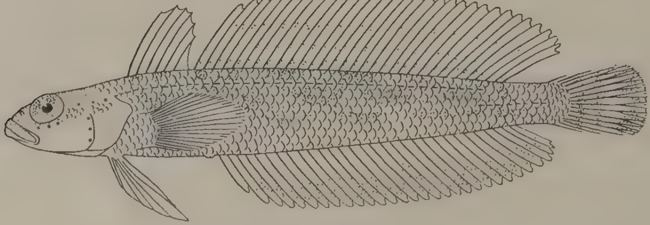

Fig. 42. *Notothenia elegans.* × $\frac{5}{8}$.

*Hab.* Patagonian-Falklands region; Straits of Magellan.

In addition to the above, there are 2 specimens (both 95 mm. long) in the British Museum collection—types of the species.

**Notothenia macrocephala, Günther.**

? *Gadus magellanicus*, Schneider [*ex* Forster MS.], 1801, in Bloch, *Syst. Ichth.*, p. 10.

? *Notothenia magellanica*, Richardson, 1844, *Zool. 'Erebus' and 'Terror'*, Fishes, p. 9.

*Notothenia macrocephala*, Günther, 1860, *Cat. Fish.*, ii, p. 263; Cunningham, 1871, *Trans. Linn. Soc. London*, xxvii, p. 470; Vaillant, 1888, *Miss. Sci. Cap Horn*, vi. Zool., Poiss., p. 27, pl. iii, fig. 2; Perugia, 1891, *Ann. Mus. Civ. stor. nat. Genova* (2) x [xxx], p. 618; Smitt, 1897, *Bih. Sv. Vet.-Akad. Handl.*, xxiii, iv, No. 3, p. 9, pl. iii, figs. 23–26; Delfin, 1901, *Cat. Peces Chile*, p. 84; Boulenger, 1900, *Ann. Mag. Nat. Hist.* (7) vi, p. 53; Boulenger, 1902, '*Southern Cross*', Pisces, p. 184; Steindachner, 1903, *Zool. Jahrb.*, Suppl. vi, p. 207; Lönnberg, 1907, *Hamb. Magalh. Sammelr.*, Fische, p. 10; Regan, 1913, *Trans. R. Soc. Edinb.*, xlix, p. 277; Hussakof, 1914, *Bull. Amer. Mus. Nat. Hist.*, xxxiii, p. 89; Waite, 1916, *Sci. Rep. Australas. Antarct. Exped.*, Ser. C, iii (1), p. 66, pl. iii, fig. 2, text-fig. 16; Thompson, 1916, *Proc. U.S. Nat. Mus.*, l, p. 431; Phillipps, 1927, *N. Zealand Mar. Dept. Fish. Bull.*, i, p. 44; Fowler, 1927, *Proc. Acad. N.S. Philad.*, lxxviii, p. 283.

? *Notothenia cornucola*, Hutton, 1873, *Trans. N. Zealand Inst.*, v, p. 262.

*Notothenia maoriensis*, Haast, 1873, *t.c.*, p. 276, pl. xvi.

*Notothenia angustata*, Hutton, 1875, *Ann. Mag. Nat. Hist.* (4) xvi, p. 315; Hutton, 1876, *Trans. N. Zealand Inst.*, viii, p. 213.

*Notothenia hassleriana*, Steindachner, 1876, *SitzBer. Akad. Wiss. Wien*, LXXII (1), p. 69, pl. vi (left-hand fig.); Steindachner, 1898, *Zool. Jahrb.*, Suppl. IV, p. 303.

*Notothenia antarctica*, Peters, 1876, *Monatsber. Akad. Berlin*, p. 837; [Studer], 1889, *Forschungsr. S.M.S. 'Gazelle'*, III, pl. xix, fig. 1.

*Notothenia arguta*, Hutton, 1879, *Trans. N. Zealand Inst.*, XI, p. 339.

*Notothenia porteri*, Delfin, 1899, *Revist. Chil.*, III, p. 117.

St. 63. 22. v. 26. 48° 50′ S, 53° 56′ W. Hand line, 0 m.: 8 specimens, 60–90 mm.

St. 222. 22–24. iv. 27. St Martin's Cove, Hermite Island, Cape Horn. Large fish trap, 30–35 m.: 1 specimen, 205 mm.

St. 229. 4. v. 27. 53° 40′ S, 61° 10′ W. 1 m. tow-net, horizontal, 46 (–0) m.: 1 specimen, 75 mm.

Depth of body 3 to 4 in the length, length of head $3\frac{1}{5}$ to $3\frac{3}{4}$. Snout (except in young) longer than eye, diameter of which is 3 (young) to 6 in length of head; interorbital width $2\frac{1}{2}$ to $3\frac{1}{2}$. Jaws equal anteriorly; maxillary extending to below anterior $\frac{1}{4}$ or anterior $\frac{1}{3}$ of eye; teeth in one or two series anteriorly in both jaws, always uniserial laterally; no distinct canines; a few imbricated scales behind the eye and on the upper part of the operculum; upper surface of head naked, papillose; 10 to 13 gill-rakers on lower part of anterior arch. Scales on body generally smooth; 50 to 60 in a lateral longitudinal series; 36 to 46 tubular scales in upper lateral line, which ends below posterior rays of dorsal, 6 to 14 in lower lateral line. Dorsal III–VI[1] 29–31; longest spine $\frac{1}{5}$ to $\frac{2}{7}$ length of head. Anal 22–25; length of base $2\frac{1}{3}$ to $2\frac{2}{3}$ in that of fish (without caudal). Pectoral $\frac{2}{3}$ to $\frac{5}{6}$ length of head, much longer than pelvics, which extend $\frac{3}{5}$ to $\frac{2}{3}$ of the distance from their base to the vent. Caudal emarginate in young, becoming truncate or even slightly rounded in adults; caudal peduncle usually somewhat longer than deep. Greyish olive above, becoming yellowish below; more or less distinct longitudinal stripes or series of spots on the sides; traces of oblique stripes below the eye; spinous dorsal dark; soft dorsal dusky, sometimes reticulated, and with a narrow pale margin; caudal, pectoral and pelvics usually more or less dusky. The young are more silvery, especially on the lower parts of the head and body, and the fins are much paler.

*Hab.* Patagonia; Falkland Islands; Straits of Magellan; coast of Chile, northwards to Talcahuano; Kerguelen; New Zealand; Auckland Island; Campbell Island; Macquarie Island.

In addition to the above, Mr Bennett has sent 8 specimens (55–220 mm.) from Stanley, Falkland Islands, taken in shallow water with hook or seine net. There are also 15 specimens (40–350 mm.) in the British Museum collection from the Falklands, Straits of Magellan, Kerguelen, New Zealand and Campbell Island, including the type of the species and the types of *N. arguta* and *N. angustata*.

Schneider's *Gadus magellanicus* was based upon the MS. and drawing of Forster (MS. IV, 46). The latter is a rough sketch but seems to represent an undoubted *Notothenia*. Since the number of anal rays is given by Schneider as 25, it seems probable that Forster's fish belonged either to this species or to the next, as all other species of *Notothenia* from the Magellan region have 27 to 35 anal rays. Thompson has expressed doubt as to the identity of *N. macrocephala* with species from Kerguelen and New Zealand, particularly on account of the wide range of variation in the number of spines in the dorsal fin (III–VI). Comparison of Magellan and New Zealand material leaves no doubt that the same species is found in both regions, and two young individuals collected by the 'Challenger' at Kerguelen agree closely with young from the Falklands. It seems probable that this and the following species are not so demersal or littoral in their habits as most of the other species, and that the silvery young are mainly pelagic.

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[1] Of 25 specimens from the Patagonian-Falklands region, 1 has 3 spines, 16 have 4, 7 have 5 and 1 has 6.

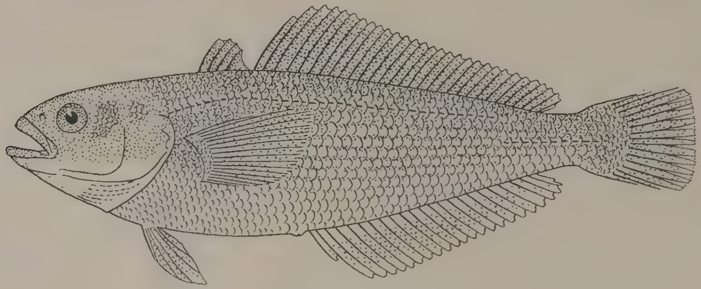

Fig. 43. *Notothenia macrocephala.* × ½.

In life this fish is blue-grey or golden-brown above, shading away to golden-yellow or cream on the belly; the branchiostegal membranes are bright orange-yellow; the dorsal fins are blue-grey, the other fins grey. It grows to a length of considerably more than a foot, and is known locally in the Falklands as "Yellow-belly". Mr Bennett notes that it is a good fish for the table, although seldom used for food. It stays later in the Falklands than the other species of *Notothenia*, and has been found to be abundant as late as 25 April.

**Notothenia microlepidota, Hutton.**

*Notothenia microlepidota*, Hutton, 1876, *Trans. N. Zealand Inst.*, VIII, p. 213; Waite, 1909, *Subantarctic Isl. N. Zealand, Pisces*, p. 590, fig.; Regan, 1913, *Trans. R. Soc. Edinb.*, XLIX, p. 277.

*Notothenia parva*, Hutton, 1879, *Trans. N. Zealand Inst.*, XI, p. 339.

*Notothenia latifrons*, Thompson, 1916, *Proc. U.S. Nat. Mus.*, L, p. 434, pl. iii, fig. 1.

*Notothenia patagonica*, MacDonagh, 1931, *Not. Prelim. Mus. La Plata*, I, p. 100; MacDonagh, 1934, *Rev. Mus. La Plata*, XXXIV, p. 84, pl. x, figs. 2, 3, pl. xi, figs. 1, 2, pl. xii, text-figs.

Depth of body about 4 in the length, length of head 3½. Snout longer than eye, diameter of which is about 6 in length of head; interorbital width 3⅔. Lower jaw very little longer than upper; maxillary extending to a little beyond middle of eye; teeth in the upper jaw in a band, which becomes narrower at the sides, those of the lower jaw in a band anteriorly, uniserial laterally; teeth of the outer series in both jaws enlarged, those in front more or less canine-like; sides of head mostly naked, some imbricated scales behind the eye and on the upper part of the operculum; upper surface of head naked, papillose; 13 gill-rakers on lower part of anterior arch. Scales on body ciliated, rough to the touch; about 58 in a lateral longitudinal series; 57 tubular scales in upper lateral line, which ends below last ray of dorsal, 12 in lower lateral line. Dorsal V (VI) 29; longest spine less than $\frac{1}{3}$ length of head. Anal 24; length of base $2\frac{1}{2}$ in that of fish (without caudal). Pectoral nearly $\frac{2}{3}$ length of head, a little longer than pelvics, which extend nearly $\frac{2}{3}$ of the distance from their base to the vent. Caudal rounded; caudal peduncle deeper than long. Brownish above, with traces of darker markings, paler beneath; sides of head reticulated; fins more or less spotted.

*Hab.* East coast of Patagonia; Straits of Magellan; New Zealand; Auckland Island; Campbell Island.

The above description is based upon a paratype of *Notothenia patagonica*, 270 mm. in total length, presented to the British Museum by Mr E. J. MacDonagh. Comparison of this specimen with authentic examples of *N. microlepidota* from New Zealand reveals no important differences, and I have no doubt that the two species are synonymous. *N. latifrons* was described from 3 young specimens from Sandy Point and Laredo Bay, the holotype being 63 mm. in total length (U.S.N.M. No. 76854), and is almost certainly identical with the New Zealand species, as was suggested by Regan (1916, *Ann. Mag. Nat. Hist.*, Ser. 8, XVIII, p. 379). There is, thus, a second species common to the Patagonian and Antipodes regions. In 4 examples from the Antipodes the number of gill-rakers on the lower part of the anterior arch varies from 11 to 13.

### Genus **Dissostichus,** Smitt

*Dissostichus*, Smitt, 1898, *Bih. Sv. Vet.-Akad. Handl.*, XXIV, IV, No. 5, p. 3. Type *D. eleginoides*, Smitt.

This genus is closely related to *Notothenia*, but differs in the form of the dentition and in the longer snout. It may also be distinguished from nearly all the species of *Notothenia* by the smaller scales and by the very long lower lateral line.

### **Dissostichus eleginoides,** Smitt.

1898, *t.c.*, p. 4, pl. i, figs. 1–11; Delfin, 1901, *Cat. Peces Chile*, p. 83; Vaillant, 1907, *Expéd. Antarct. Franç.*, Poiss., p. 36; Regan, 1913, *Trans. R. Soc. Edinb.*, XLIX, p. 279; Devincenzi, 1924, *Anal. Mus. Montevideo* (II) I (5), p. 264.

St. WS 75. 10. iii. 27. 51° 01′ 30″ S, 60° 31′ W. Commercial otter trawl, 72 m.: 1 specimen, 130 mm.

St. WS 97. 18. iv. 27. 49° 00′ 30″ S, 61° 58′ W. Commercial otter trawl, 146–145 m.: 1 specimen, 330 mm.

St. WS 98. 18. iv. 27. 49° 54′ 15″ S, 60° 35′ 30″ W. Commercial otter trawl, 173–171 m.: 2 specimens, 295, 320 mm.

St. WS 245. 18. vii. 28. 52° 36′ S, 63° 40′ W. Commercial otter trawl, 304–290 m.: 2 specimens, 445, 900 mm.

St. WS 839. 5. ii. 32. 53° 30′ 15″ S, 63° 29′ W. Commercial otter trawl, 403–434 m.: 2 specimens, 630, 640 mm.

Depth of body $4\frac{4}{5}$ to more than 6 in the length, length of head $2\frac{7}{8}$ to 3. Snout $1\frac{3}{5}$ times to nearly twice as long as eye, diameter of which is $5\frac{1}{2}$ to $6\frac{1}{2}$ in length of head; interorbital width $4\frac{1}{2}$ to 5. Lower jaw strongly projecting; maxillary extending to below middle or posterior part of eye; teeth biserial in upper jaw, those of the outer row enlarged, spaced, canine-like; a group of stronger canine teeth on each praemaxillary; teeth in lower jaw uniserial, spaced, canine-like; upper surface of head (except snout and praeorbital), cheeks and opercles covered with small scales; some of the mucous pores on the head enlarged, situated at the ends of elongate naked areas symmetrically arranged on upper surface of head, on praeorbital and on suborbitals; about 11 or 12 small spinate gill-rakers on lower part of anterior arch. Scales on body more or less smooth; 110 to 120 in a lateral longitudinal series; about 95 tubular scales in upper lateral line, which extends to below posterior part of dorsal or beyond; about 64 in lower lateral line, which extends forward to or nearly to pectoral fin. Dorsal IX–X 26–29. Anal 26–30. Pectoral $\frac{3}{5}$ to nearly $\frac{3}{4}$ length of head, much longer than the pelvics, which do not nearly reach the vent. Caudal truncate or a little emarginate; caudal peduncle longer than deep. More or less uniformly brownish, or with indistinct darker markings; spinous dorsal dusky distally.

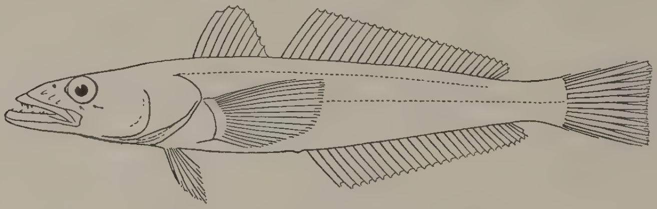

Fig. 44. *Dissostichus eleginoides.* × $\frac{1}{3}$.

*Hab.* Coast of Argentina; Patagonian-Falklands region; Straits of Magellan; Graham Land.

This species was previously unrepresented in the British Museum collection. I have dissected the shoulder girdle in one of the above specimens, and find the arrangement of the hypercoracoid, hypocoracoid, and radials very similar to that of *Notothenia*.

### Genus **Eleginops**, Gill

*Eleginus* (*non* Fischer, 1813), Cuvier and Valenciennes, 1830, *Hist. Nat. Poiss.*, v, p. 158; Günther, 1860, *Cat. Fish.*, ii, p. 247. Type *E. maclovinus*, Cuvier and Valenciennes.

*Eleginops*, Gill, 1862, *Proc. Acad. N.S. Philad.* (1861), p. 522; Gill, 1891, *Proc. U.S. Nat. Mus.*, xiv, p. 305; Regan, 1913, *Trans. R. Soc. Edinb.*, xlix, p. 279. Type *Aphritis undulatus*, Jenyns.

This genus differs from *Notothenia* in the rather small mouth, in the complete absence of the lower lateral line, and in the shape of the pectoral fin.

**Eleginops maclovinus** (Cuvier and Valenciennes). "Hiamouch"; "Róbalo."

*Eleginus maclovinus*, Cuvier and Valenciennes, 1830, *Hist. Nat. Poiss.*, v, p. 158, pl. cxv; Guichenot, 1848–9, in Gay, *Hist. Chile*, Zool. ii, p. 186; Günther, 1860, *Cat. Fish.*, ii, p. 247; Cunningham, 1871, *Trans. Linn. Soc. London*, xxvii, p. 469; Steindachner, 1876, *SitzBer. Akad. Wiss. Wien*, lxxii (1), p. 65; Günther, 1880, *Shore Fish. 'Challenger'*, p. 21; Günther, 1881, *Proc. Zool. Soc.*, p. 20; Vaillant, 1888, *Miss. Sci. Cap Horn*, vi. Zool., Poiss., p. 28; Perugia, 1891, *Ann. Mus. Civ. stor. nat. Genova* (2) x [xxx], p. 616; Berg, 1895, *Anal. Mus. Nac. B. Aires*, iv, p. 64; Smitt, 1898, *Bih. Sv. Vet.-Akad. Handl.*, xxiv, iv, No. 5, p. 23; Steindachner, 1898, *Zool. Jahrb.*, Suppl. iv, p. 299; Boulenger 1900, *Ann. Mag. Nat. Hist.* (7) vi, p. 52; Delfin, 1901, *Cat. Peces Chile*, p. 101.

*Atherina macloviana*, Lesson, 1830, *Voy. 'Coquille'*, Zool., Poiss., Atlas, pl. xvii.

*Eleginus chilensis*, Cuvier and Valenciennes, 1833, *Hist. Nat. Poiss.*, ix, p. 480; Guichenot, 1848–9, in Gay, *Hist. Chile*, Zool. ii, p. 187, pl. iii, fig. 1; Günther, 1860, *Cat. Fish.*, ii, p. 247.

*Aphritis undulatus*, Jenyns, 1842, *Zool. 'Beagle'*, Fish., p. 160, pl. xxix, fig. 1; Guichenot, 1848–9, *t.c.*, p. 168; Günther, 1860, *t.c.*, p. 243; Perugia, 1891, *Ann. Mus. Civ. stor. nat. Genova* (2) x [xxx], p. 616.

*Aphritis porosus*, Jenyns, 1842, *t.c.*, p. 162; Günther, 1860, *t.c.*, p. 243.

*Eleginus falklandicus*, Richardson, 1845, *Zool. 'Erebus' and 'Terror'*, Fishes, p. 30, pl. xx, figs. 1–3.

*Eleginus magellani*, Sauvage, 1880, *Bull. Soc. Philom. Paris* (7) iv, p. 223.

*Phricus porosus*, Berg, 1895, *Anal. Mus. Nac. B. Aires*, iv, p. 65.

*Eleginops maclovinus*, Dollo, 1904, *Rés. Voy. 'Belgica'*, Poiss., p. 80; Lönnberg, 1907, *Hamb. Magalh. Sammelr.*, Fische, p. 11; Regan, 1913, *Trans. R. Soc. Edinb.*, xlix, p. 279; Thompson, 1916, *Proc. U.S. Nat. Mus.*, l, pp. 424, 467.

St. WS 586. 8. v. 31. 48° 27′ 30″ S, 74° 23′ 30″ W. Hand line, 22 m.: 1 specimen, 320 mm.

St. 724. 16. xi. 31. Fortescue Bay, Magellan Straits. Seine net, 0–5 m.: 3 specimens, 160–180 mm.

Depth of body $4\frac{1}{4}$ to $5\frac{1}{2}$ in the length, length of head $3\frac{1}{4}$ to 4. Snout (except in very young) longer than eye, diameter of which is $4\frac{1}{2}$ (young) to 8 in length of head; interorbital width 3 to 5. Lower jaw a little shorter than upper; maxillary just reaching vertical from anterior margin of eye in the young, but not in the adult; teeth in bands in both jaws; occiput, interorbital region, cheeks and opercles scaled; mucous pores on head associated with elongate naked areas as in *Dissostichus*; 14 or 15 gill-rakers on lower part of anterior arch. Scales on body ctenoid; about 60 in a lateral longitudinal series, and 65 in the lateral line, which nearly reaches the caudal fin. Dorsal VIII or IX 24–26. Anal 22–24. Pectoral obliquely truncated, with the upper rays longest, nearly as long as head; much longer than pelvics, which do not nearly reach the vent. Caudal truncate in the young, a little emarginate in the adult. Brownish or greyish above, paler below; body uniform, or spotted and marbled with darker; dorsal and caudal fins more or less dusky; anal yellowish-white; pectorals and pelvics yellowish, their distal parts sometimes dusky.

*Hab.* Coasts of Argentina, Patagonia and Chile;[1] Falkland Islands.

In addition to the above, Mr Bennett has sent 6 specimens (65–290 mm.), mostly from Weir Creek, Stanley, Falkland Islands, taken with a seine net in March, November and December. There are also about 25 specimens (120–450 mm.) in the British Museum collection, from various localities, including the types of *Aphritis undulatus*, *A. porosus* and *Eleginus falklandicus*. There are 2 fine specimens (300 and 320 mm.) from near Talcahuano, Chile, received from Mr Cavendish Bentinck.

This fish is one of the commonest of those of the Falklands, and is known locally as "Mullet". It grows to a length of about 2 ft. and a weight of 15 lb., but, as the flesh is often very muddy in taste, it is not a first-class fish for the table, although commonly used for food. Mullet enter sandy bays, creeks and estuaries in numbers, and are said to be caught by men entering the water and driving them ashore. Mr Bennett notes that it is a fish of rapid movement, fond of basking in quiet bays during sunshine, and becoming most active in the last few hours of the rising tide. As the tide rises the fish run into very shallow water, even up the freshwater streams, and are often isolated there until the next high tide.

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[1] This species extends northwards to the Rio Plata on the east coast and to northern Chile on the west coast.

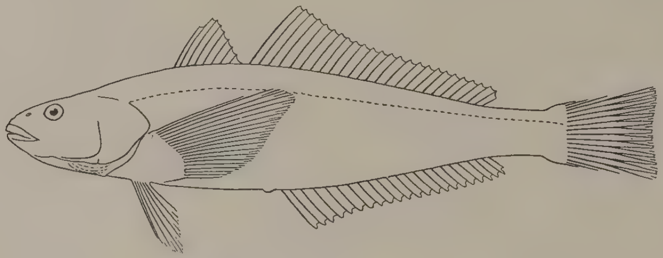

Fig. 45. *Eleginops maclovinus.* × ⅓.

## Genus Harpagifer, Richardson

*Harpagifer*, Richardson, 1844, *Zool. 'Erebus' and 'Terror'*, Fishes, p. 11; Regan, 1913, *Trans. R. Soc. Edinb.*, XLIX, p. 280. Type *Batrachus bispinis*, Schneider.

This genus differs from *Notothenia* in the naked body, the broad union of the gill-membranes to the isthmus, the hooked operculum, and the development of the operculum and suboperculum as strong spines.

**Harpagifer bispinis** (Schneider).

*Batrachus bispinis*, Schneider [*ex* Forster MS.], 1801, in Bloch, *Syst. Ichth.*, p. 45.

*Callionymus bispinis*, Forster, 1844, *Anim. Mar. Aust.*, p. 360.

*Harpagifer bispinis*, Richardson, 1844, *Zool. 'Erebus' and 'Terror'*, Fishes, pp. 11, 19, pl. vii, figs. 1–3, pl. xii, figs. 8, 9; Günther, 1860, *Cat. Fish.*, II, p. 263; Cunningham, 1871, *Trans. Linn. Soc. London*, XXVII, p. 470; Vaillant, 1888, *Miss. Sci. Cap Horn*, VI. Zool., Poiss., p. 23; Perugia, 1891, *Ann. Mus. Civ. stor. nat. Genova* (2) x [xxx], p. 620; Smitt, 1898, *Bih. Sv. Vet.-Akad. Handl.*, XXIV, IV, No. 5, p. 17; Steindachner, 1898, *Zool. Jahrb.*, Suppl. IV, p. 306; Delfin, 1901, *Cat. Peces Chile*, p. 87; Lönnberg, 1905, *Wiss. Ergebn. Schwed. Südpol.-Exped.*, v (6), p. 8; Lönnberg, 1907, *Hamb. Magalh. Sammelr.*, Fische, p. 11; Regan, 1913, *Trans. R. Soc. Edinb.*, XLIX, p. 280; Hussakof, 1914, *Bull. Amer. Mus. Nat. Hist.*, XXXIII, p. 90.

*Harpagifer palliolatus*, Richardson, 1844, *t.c.*, p. 20, pl. xii, figs. 5–7.

St. WS 89. 7. iv. 27. 9 miles N 21° E of Arenas Point Light, Tierra del Fuego. Commercial otter trawl, 23–21 m.: 2 specimens, 55, 67 mm.

St. WS 749. 18. ix. 31. 52° 39′ 30″ S, 69° 53′ 30″ W. Rectangular net, 40 m.: 3 specimens, 45–48 mm.

Dorsal III–V 21–26. Anal 16–21. Coloration very variable, the body generally with dark bars or blotches.

*Hab.* Patagonia; Falkland Islands; Straits of Magellan; Graham Land; South Georgia; South Orkneys; Marion Islands; Kerguelen; Macquarie Island.

In addition to the above, Mr Bennett has sent 24 specimens (48–95 mm.) from Stanley, Falkland Islands, taken under stones between tide-marks from September to December; as well as 3 others (60–70 mm.) collected near the beach at New Island, West Falklands, by Mr Hamilton in February, 1934. There are also numerous specimens up to 100 mm. in total length in the British Museum collection, from various localities, including the type of *Harpagifer palliolatus*.

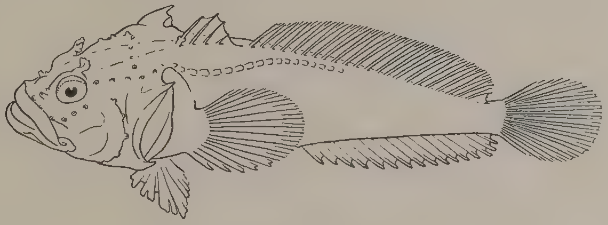

Fig. 46. *Harpagifer bispinis*. × 1.

This is mainly a shore fish, occurring in tide pools and under rocks, and also to be found in the "kelp" in shallow water. Hussakof records an individual, 61 mm. long, which was collected at Tierra del Fuego on 30 March, and was distended with eggs, each of which measured about 1·5 mm. in diameter.

## CHAENICHTHYIDAE

**Champsocephalus esox** (Günther). "Tsataki."

*Chaenichthys esox*, Günther, 1861, *Ann. Mag. Nat. Hist.* (3) VII, p. 89; Cunningham, 1871, *Trans. Linn. Soc. London*, XXVII, p. 469; Günther, 1881, *Proc. Zool. Soc.*, p. 20; Vaillant, 1888, *Miss. Sci. Cap Horn*, VI. Zool., Poiss., p. 27; Perugia, 1891, *Ann. Mus. Civ. stor. nat. Genova* (2) X [XXX], p. 616; Smitt, 1898, *Bih. Sv. Vet.-Akad. Handl.*, XXIV, IV, No. 5, p. 7; Delfin, 1901, *Cat. Peces Chile*, p. 102.

*Champsocephalus esox*, Gill, 1862, *Proc. Acad. N.S. Philad.* (1861), p. 510; Lönnberg, 1907, *Hamb. Magalh. Sammelr.*, Fische, p. 10; Regan, 1913, *Trans. R. Soc. Edinb.*, XLIX, p. 285, pl. X, fig. 1.

St. 51. 4. v. 26. Off Eddystone Rock, East Falkland Islands. Large otter trawl, 105–115 m.: 21 specimens, 150–190 mm.

St. WS 73. 6. iii. 27. 51° 01′ S, 58° 54′ W. Commercial otter trawl, 121 m.: 6 specimens, 140–290 mm.

St. WS 75. 10. iii. 27. 51° 01′ 30″ S, 60° 31′ W. Commercial otter trawl, 72 m.: 22 specimens, 140–220 mm.

St. WS 83. 24. iii. 27. 14 miles S 64° W of George Island, East Falkland Islands. Commercial otter trawl, 137–129 m.: 6 specimens, 303–330 mm.

St. 724. 16. xi. 31. Fortescue Bay, Magellan Straits. Seine net, 0–5 m.: 2 specimens, 100, 130 mm.

St. WS 823. 19. i. 32. 52° 14′ 30″ S, 60° 01′ W. Commercial otter trawl, with net (7 mm. mesh) attached, 80–95 m.: 5 specimens, 120–180 mm.

St. WS 834. 2. ii. 32. 52° 57′ 45″ S, 68° 08′ 15″ W. Net (7 mm. mesh) attached to back of trawl, 27–38 m.: 1 specimen, 105 mm.

Depth of body 7 to 8 in the length, length of head $2\frac{4}{5}$ to $3\frac{1}{3}$. Snout as long as or a little longer than postorbital part of head; diameter of eye $5\frac{1}{4}$ (young) to $7\frac{1}{2}$ in length of head; interorbital width $3\frac{1}{2}$ to 5. Maxillary extending to below anterior part or middle of eye. Dorsal IX–X 32–37. Anal 31–35. Body with dark cross-bars, or irregularly mottled or blotched with darker.

*Hab.* Patagonian-Falklands region; Straits of Magellan.

In addition to the above, Mr Bennett has sent 3 specimens (195–250 mm.) from Stanley, Falkland Islands. There are also 6 specimens (145–330 mm.) in the British Museum collection from various localities in Patagonia and the Straits of Magellan, as well as the type of the species, a stuffed skin (340 mm.) from Port Famine.

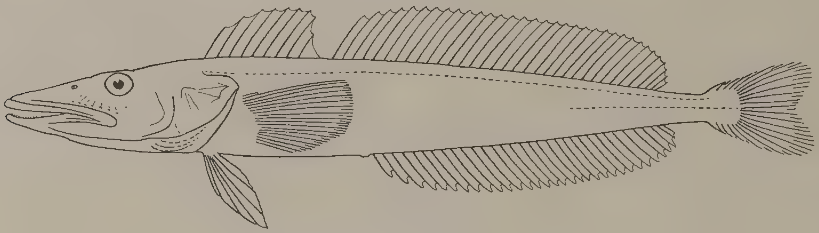

Fig. 47. *Champsocephalus esox.* × $\frac{2}{5}$.

Dr R. O. Cunningham has recorded that in life the sides of this fish are barred with greyish black and fine iridescent purple. Mr Bennett notes that it is not common in the Falklands, but is occasionally taken from January to March. Its local name is "Pike", and, although rarely eaten, is said to be a good food-fish.

## GEMPYLIDAE

**Thyrsites atun** (Euphrasen).

*Scomber atun*, Euphrasen, 1791, *K. Vet. Acad. Nya. Handl.*, XII, p. 315.

*Thyrsites atun*, Cuvier and Valenciennes, 1831, *Hist. Nat. Poiss.*, VIII, p. 196, pl. ccxix; Valenciennes, 1850, in Cuvier, *R. Anim.*, Disciples Ed., Poiss., pl. xlix, fig. 1; Günther, 1860, *Cat. Fish.*, II, p. 350; Vaillant, 1888, *Miss. Sci. Cap Horn*, VI. Zool., Poiss., p. 29; Delfin, 1901, *Cat. Peces Chile*, p. 50; Lahille, 1913, *Anal. Mus. Nac. B. Aires*, XXIV, p. 14, pl. v, fig. 1; McCulloch, 1921, *Rec. Austral. Mus.*, XIII, p. 139, pl. XXIV, fig. 2; Barnard, 1927, *Ann. S. Afric. Mus.*, XXI, p. 788, pl. xxix, fig. 4; Phillipps, 1927, *N. Zealand Mar. Dept. Fish. Bull.*, I, p. 47.

*Thyrsites chilensis*, Cuvier and Valenciennes, 1831, *Hist. Nat. Poiss.*, VIII, p. 204; Guichenot, 1848–9, in Gay, *Hist. Chile*, Zool. II, p. 226.

*Thyrsites altivelis*, Richardson, 1839, *Proc. Zool. Soc.*, VII (78), p. 99.

St. WS 96. 17. iv. 27. 48° 00′ 45″ S, 64° 58′ W. Commercial otter trawl, 90 m.: 1 specimen, 920 mm.

St. WS 812. 10. i. 32. From 51° 16′ 15″ S, 68° 52′ W to 51° 19′ 45″ S, 68° 40′ W. Commercial otter trawl, 43–84 m.: 5 specimens, 900–950 mm.

*Hab.* South Africa; Tristan da Cunha; Argentina, Patagonian-Falklands region, Chile; southern Australia; New Zealand.

In addition to the above, Mr Bennett has sent the head of a specimen caught in East Falkland Island in February, 1927. This fish was taken in the Murrell River at Island Pass, a freshwater stream at some distance from the sea.

This is the species known in South Africa as "Snoek", in Australia and New Zealand as "Barracouta", and in Chile as "Sierra".

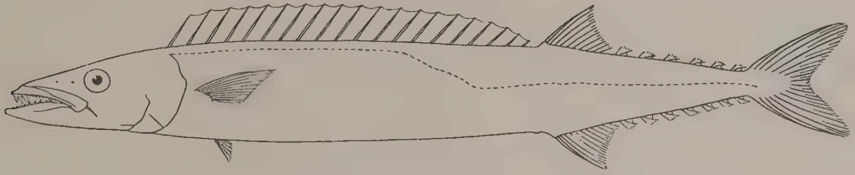

Fig. 48. *Thyrsites atun.* × 1/6.

## SCOMBRIDAE

### Genus Gasterochisma, Richardson

1845, *Ann. Mag. Nat. Hist.*, xv, p. 346; Richardson, 1846, *Zool. 'Erebus' and 'Terror'*, Fishes, p. 60; Regan, 1902, *Ann. Mag. Nat. Hist.* (7) x, p. 120. Type *G. melampus*, Richardson.

*Lepidothynnus*, Günther, 1889, *Pelagic Fish. 'Challenger'*, p. 15. Type *L. huttoni*, Günther.

*Chenogaster*, Lahille, 1903, *Anal. Mus. Nac. B. Aires*, ix, p. 375; Lahille, 1905, *Anal. Mus. Nac. B. Aires*, xi, p. 461. Type *C. holmbergi*, Lahille.

The systematic position of this genus is clearly with the Scombridae rather than with the Stromateidae, as has been shown by Regan. There is probably only a single species.

**Gasterochisma melampus**, Richardson.

*Gasterochisma melampus*, Richardson, 1845, *Ann. Mag. Nat. Hist.*, xv, p. 346; Richardson, 1846, *Zool. 'Erebus' and 'Terror'*, Fishes, p. 60, pl. xxxvii, figs. 1–3; Regan, 1902, *Ann. Mag. Nat. Hist.* (7) x, p. 120; Stead, 1907, *Add. Fish-Fauna N.S. Wales* [1], p. 21, pl. vi; Waite, 1913, *Trans. N. Zeal. Inst.*, xlv, p. 220, pl. viii; McCulloch, 1922, *Austral. Zool.*, ii, p. 104, pl. xxxiii, fig. 287*a*; Phillipps, 1927, *N. Zealand Mar. Dept. Fish. Bull.*, i, p. 45.

*Lepidothynnus huttoni*, Günther, 1889, *Pelagic Fish. 'Challenger'*, p. 15, pl. vi, fig. A.

*Chenogaster holmbergi*, Lahille, 1903, *Anal. Mus. Nac. B. Aires*, ix, p. 375; Lahille, 1905, *Anal. Mus. Nac. B. Aires*, xi, p. 461, pl. i.

*Gasterochisma boulengeri*, Lahille, 1913, *Anal. Mus. Nac. B. Aires*, xxiv, p. 8, pls. iii, iv, text-fig. 2.

*Hab.* Southern Atlantic and Pacific Oceans.

No specimens of this interesting oceanic species were obtained by the Discovery Expedition, but Mr Hamilton has sent portions of a damaged skeleton from the Falkland Islands, together with a photograph of a stuffed specimen, nearly 4 feet in length, in the museum at Stanley. This specimen is from West Point Island. There are also some scales, sent to the British Museum by Mr R. Vallentin in 1911, taken from a fish from the north-west corner of West Falklands. The type of *G. melampus* is about 200 mm. in total length, that of *G. boulengeri* was 725 mm., that of *Chenogaster holmbergi* was about 1550 mm., and that of *Lepidothynnus huttoni* was about 1680 mm. These specimens form a complete series, and I have no doubt that they represent different stages in the growth of a single species. A similar change in the size of the pectoral, and particularly of the pelvic fins, with age, is met with in such genera as *Nomeus*, *Psenes*, *Leirus*, etc.

## ZOARCIDAE

In 1908, Lahille (*Anal. Mus. Nac. B. Aires*, XVI, p. 403) published an account of the genera and species found on the coast of Argentina, but, as his paper was omitted from the Zoological Record, it was overlooked by Regan when he prepared a revision of the South American and Antarctic Zoarcidae in 1913 (*Trans. R. Soc. Edinb.*, XLIX, p. 241). In view of the very extensive material obtained by the Discovery Expedition, it has seemed desirable to prepare a new revision of the species from the Patagonian region, leaving those of South Georgia and the Antarctic to be dealt with in the next part of this report.

### *Key to the Patagonian genera*

I. Pelvic fins present.
  A. Snout and lower jaw without fringes.
    1. Origin of dorsal fin well behind base of pectoral; gill-opening cleft downward nearly to lower end of base of pectoral; eye large, $3\frac{1}{3}$ in head ... *OPHTHALMOLYCUS*.
    2. Origin of dorsal fin above base or anterior part of pectoral; eye smaller, more than $3\frac{1}{2}$ in head (except in young).
      *a*. Gill-opening cleft downward at least to middle of base of pectoral.
        (i) Gill-opening cleft downward almost or quite to lower end of base of pectoral; head not depressed; canine teeth usually present, at least in lower jaw *ILUOCOETES*.
        (ii) Gill-opening cleft downward only to middle of base of pectoral; head more or less depressed; no canine teeth ... ... ... ... *AUSTROLYCUS*.
      *b*. Gill-opening small, above the pectoral; head not depressed ... *PHUCOCOETES*.
  B. Snout and lower jaw with dermal fringes.
    1. Teeth conical, in 2 or more series in both jaws; small scales embedded in the skin.
      *a*. Gill-opening almost entirely above the pectoral; palate toothless *CROSSOSTOMUS*.
      *b*. Gill-opening cleft downward to middle of base of pectoral; teeth on palate *POGONOLYCUS*.
    2. Teeth incisor-like, uniserial; palate toothless; skin naked; gill-opening cleft downward to middle of base of pectoral ... ... ... ... ... ... ... *PLATEA*.
II. No pelvic fins.
  A. Gill-opening cleft downward to middle of base of pectoral ... ... ... *MAYNEA*.
  B. Gill-opening above base of pectoral ... ... ... ... ... *MELANOSTIGMA*.

### Genus **Ophthalmolycus**, Regan

1913, *Trans. R. Soc. Edinb.*, XLIX, p. 243. Type *Lycodes macrops*, Günther.

Form elongate, compressed. Mouth subterminal; teeth rather slender and acute, in about 3 series in both jaws; no canines; 3 teeth on vomer and 2 near anterior end of each palatine. Gill-opening rather wide, cleft downward nearly to lower end of base of pectoral. Dorsal origin well behind head; pelvic fins present.

**Ophthalmolycus macrops** (Günther).

*Lycodes macrops*, Günther, 1880, *Shore Fish. 'Challenger'*, p. 21, pl. xi, fig. B.
*Ophthalmolycus macrops*, Regan, 1913, *t.c.*, p. 243.

Depth of body $11\frac{1}{2}$ in the length, length of head $5\frac{1}{3}$. Diameter of eye $3\frac{1}{3}$ in length of head and 7 times interorbital width. Maxillary nearly reaching vertical from posterior margin of eye. About 90 rays in the dorsal fin, 80 in the anal, and 10 in the caudal. Origin of dorsal above posterior $\frac{1}{4}$ of pectoral; origin of anal a head-length behind the head. Pectoral less than $\frac{1}{2}$ the length of head. Yellowish; 9 broad dark-brown cross-bars on back, extending on to dorsal fin; a series of brown spots on the side, alternating with the bars; a brown band from eye to operculum.

*Hab.* Straits of Magellan, 40 to 140 fathoms.

Known only from the type, 135 mm. in total length.

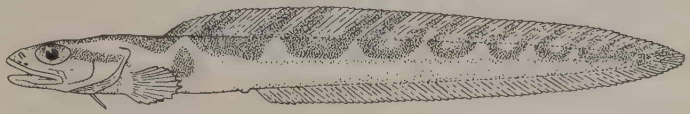

Fig. 49. *Ophthalmolycus macrops*. Holotype. × $\frac{3}{4}$.

## Genus Iluocoetes, Jenyns

1842, *Zool. 'Beagle'*, Fish., p. 165; Regan, 1913, *Trans. R. Soc. Edinb.*, XLIX, p. 243. Type *Iluocoetes fimbriatus*, Jenyns.

*Caneolepis*, Lahille, 1908, *Anal. Mus. Nac. B. Aires*, XVI, p. 431. Type *C. acropterus*, Lahille.

Head about as broad as deep; body compressed. Mouth subterminal; teeth conical, present in jaws and on vomer and palatines; canines usually developed, at least in lower jaw. Gill-opening cleft downward almost or quite to lower end of base of pectoral. Dorsal origin just behind head, above base of pectoral; pelvic fins present.

Two species.

**Iluocoetes fimbriatus**, Jenyns (Plate I, fig. 4).

*Iluocoetes fimbriatus*, Jenyns, 1842, *Zool. 'Beagle'*, Fish., p. 166, pl. xxix, fig. 2; Guichenot, 1848–9, in Gay, *Hist. Chile*, Zool. II, p. 288; Delfin, 1901, *Cat. Peces Chile*, p. 98; Lönnberg, 1905, *Wiss. Ergebn. Schwed. Südpol.-Exped.* v (6), p. 8; Lönnberg, 1907, *Hamb. Magalh. Sammelr.*, Fische, p. 13; Lahille, 1908, *Anal. Mus. Nac. B. Aires*, XVI, p. 430; Regan, 1913, *Trans. R. Soc. Edinb.*, XLIX, pp. 238, 243.

*Lycodes variegatus*, Günther, 1862, *Cat. Fish.*, IV, p. 322; Vaillant, 1888, *Miss. Sci. Cap Horn*, VI. Zool., Poiss., p. 21; Steindachner, 1898, *Zool. Jahrb.*, Suppl. IV, p. 321.

*Phucocoetes variegatus effusus*, Smitt, 1898, *Bih. Sv. Vet.-Akad. Handl.*, XXIV, IV, No. 5, p. 43, pl. v, fig. 32.

*Phucocoetes variegatus micropus*, Smitt, 1898, *t.c.*, p. 43, pl. v, fig. 33.

*Phucocoetes variegatus macropus* (part), Smitt, 1898, *t.c.*, p. 44, pl. v, fig. 36.

*Phucocoetes variegatus*, Delfin, 1901, *Cat. Peces Chile*, p. 97; Lönnberg, 1905, *Wiss. Ergebn. Schwed. Südpol.-Exped.* v (6), pp. 8, 19, pl. i, fig. 5; Devincenzi, 1924, *Anal. Mus. Montevideo* (II) I (5), p. 270.

*Caneolepis acropterus*, Lahille, 1908, *Anal. Mus. Nac. B. Aires*, XVI, p. 431, pl. vii, figs. 1–10.

St. 51. 4. v. 26. Off Eddystone Rock, East Falkland Islands. From 7 miles N 50° E to 7·6 miles N 63° E of Eddystone Rock. Large otter trawl, 115–105 m.: 4 specimens, 70–85 mm.

St. WS 71. 23. ii. 27. 6 miles N 60° E of Cape Pembroke Light, East Falkland Islands. Commercial otter trawl, 82 m.: 1 specimen, 155 mm.

St. WS 98. 18. iv. 27. 49° 54′ 15″ S, 60° 35′ 30″ W. Commercial otter trawl, 173–171 m.: 2 specimens, 285, 340 mm.

St. WS 210. 29. v. 28. 50° 17′ S, 60° 06′ W. Nets (4 and 7 mm. mesh) attached to back of trawl, 161 m.: 5 specimens, 70–205 mm.

St. WS 212. 30. v. 28. 49° 22′ S, 60° 10′ W. Nets attached to back of trawl, 242–249 m.: 2 specimens, 64, 210 mm.

St. WS 214. 31. v. 28. 48° 25′ S, 60° 40′ W. Net (7 mm. mesh) attached to back of trawl, 208–219 m.: 2 specimens, 65, 230 mm.

St. WS 216. 1. vi. 28. 47° 37′ S, 60° 50′ W. Net (7 mm. mesh) attached to back of trawl, 219–133 m.: 5 specimens, 72–140 mm.

St. WS 218. 2. vi. 28. 45° 45′ S, 59° 35′ W. Commercial otter trawl, 311–247 m.: 1 specimen, 400 mm.

St. WS 244. 18. vii. 28. 52° 00′ S, 62° 40′ W. Net (7 mm. mesh) attached to back of trawl, 253–247 m.: 2 specimens, 58, 66 mm.

St. WS 246. 19. vii. 28. 52° 25′ S, 61° 00′ W. Net (7 mm. mesh) attached to back of trawl, 267–208 m.: 1 specimen, 62 mm.

St. WS 765. 17. x. 31. 45° 07′ S, 60° 28′ 15″ W. Net (7 mm. mesh) attached to back of trawl, 113–118 m.: 1 specimen, 80 mm.

St. WS 784. 5. xii. 31. 49° 47′ 45″ S, 61° 05′ W. Nets attached to back of trawl, 170–164 m.: 6 specimens, 38–125 mm.

St. WS 792. 15. xii. 31. 45° 52′ 30″ S, 62° 11′ 15″ W. Seine net attached to back of trawl, 106–112 m.: 1 specimen, 155 mm.

St. WS 795. 18. xii. 31. 46° 14′ S, 60° 24′ W. Commercial otter trawl, 157–161 m.: 1 specimen, 330 mm.

St. WS 801. 22. xii. 31. 48° 26′ 15″ S, 61° 28′ W. Seine net attached to back of trawl, 165–165 m.: 1 specimen, 150 mm.

St. WS 811. 10–12. i. 32. 51° 24′ 30″ S, 67° 53′ W. Net (4 mm. mesh) attached to back of trawl, 96–98 m.: 1 specimen, 180 mm.

St. WS 812. 10–12. i. 32. 51° 16′ 15″ S, 68° 52′ W. Net (7 mm. mesh) attached to back of trawl, 53–55 m.: 1 specimen, 90 mm.

St. WS 821. 18. i. 32. 52° 55′ 45″ S, 60° 55′ W. Net (4 mm. mesh) attached to back of trawl, 461–468 m.: 1 specimen, 108 mm.

St. WS 825. 28–29. i. 32. 50° 50′ S, 57° 15′ 15″ W. Commercial otter trawl, with net (7 mm. mesh) attached, 135–144 m.: 1 specimen, 195 mm.

St. WS 829. 31. i. 32. 50° 51′ S, 63° 13′ 30″ W. Rectangular net, 155 (–0) m.: 1 specimen, 155 mm.

St. WS 855. 22. iii. 32. 45° 58′ 30″ S, 64° 11′ W. Net (7 mm. mesh) attached to back of trawl, 115–110 m.: 1 specimen, 102 mm.

St. WS 856. 23. iii. 32. 46° 35′ S, 64° 11′ W. Small beam trawl, 104–104 m.: 1 specimen, 135 mm.

St. WS 869. 31. iii. 32. 52° 15′ 30″ S, 64° 13′ 45″ W. Small beam trawl, 187–201 m.: 1 specimen, 69 mm.

Small scales embedded in the skin. Depth of body 7 to 11½ in the length, length of head 4½ to 5½. Diameter of eye 3 (young) to nearly 6 in length of head and 3 or 4 times interorbital width. Maxillary extending to below middle or posterior part of eye; lower jaw much shorter than upper; teeth conical, uniserial at sides of jaws but in 2 to 4 series anteriorly in adults; 1 or 2 pairs of canines at symphysis in upper jaw; usually 1 or 2 teeth on each side of lower jaw enlarged and canine-like; a patch of teeth on the vomer and a single series on each palatine. 80 to 85 rays in the dorsal fin, 65 to 70 in the anal; distance from head to origin of anal equal to or rather greater than length of head. Pectoral ½ to ⅔, pelvic about ⅕ the length of head. Coloration very variable; head, body and fins variously spotted and marbled with paler and darker, with or without dark cross-bars on back and upper parts of sides; usually with numerous smallish, rounded or oblong, pale yellowish or white spots scattered over head and upper parts of body, extending on to the dorsal fin; these spots are large and very distinct in some large individuals (? males), in which the ground colour is dark brown or black (Plate I, fig. 4); in other large specimens (? females) the spots are few, smaller and less prominent; a more or less distinct brown or black band directed forward from the eye, sometimes uniting with that of the opposite side on the end of the snout; sometimes another but less distinct band from eye to operculum; usually a series of black spots at edge of anterior part of dorsal fin; anal plain or with similar spots; pectoral uniformly yellowish (young), with a large dusky area and a pale hinder margin (half-grown), or dark brown or black with round white spots (large males?).

*Hab.* Coasts of Argentina; Patagonian-Falklands region; Straits of Magellan; southern Chile.

In addition to the above, there are 8 specimens (80–145 mm.) in the British Museum collection from the Falkland Islands and the Chiloe Archipelago, including the type of the species (145 mm.) and the types of *Lycodes variegatus* (100, 120 mm.).

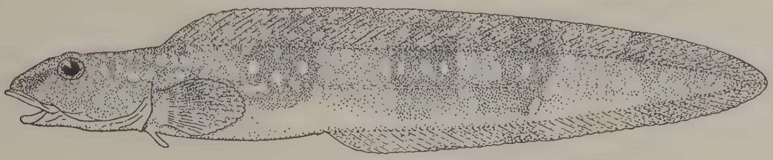

Fig. 50. *Iluocoetes fimbriatus*. × ½.

Examination of the large series of specimens listed above reveals considerable variation, not only in the coloration and in the height of the dorsal fin, but also to some extent in the size of the eye and of the cleft of the mouth: I am convinced, however, that they are all referable to a single species. Comparatively few of the specimens have ripe gonads, but, judging from the individuals which I have been able to sex, it seems fairly certain that the large, white-spotted specimens with an exceptionally high dorsal fin (Plate I, fig. 4), described by Lahille as *Caneolepis acropterus*, are mature males.[1] Young specimens collected by the 'William Scoresby' agree almost exactly with the young fish figured by Smitt as *Phucocoetes variegatus* forma *macropus*.

The specimen sketched in water-colours by Mr E. R. Gunther had been in formalin for a few days, but its colour did not appear to have changed.

**Iluocoetes elongatus** (Smitt).

*Phucocoetes variegatus elongatus*, Smitt, 1898, *Bih. Sv. Vet.-Akad. Handl.*, XXIV, IV, No. 5, p. 44, pl. V, fig. 34.

St. WS 749. 18. ix. 31. 52° 39′ 30″ S, 69° 53′ 30″ W. Rectangular net, 40 m.: 17 specimens, 83–145 mm.

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[1] Lahille points out that one of the four types of *Caneolepis acropterus* is a male, but he was unable to ascertain the sex of the others.

St. WS 834. 2. ii. 32. 52° 57′ 45″ S, 68° 08′ 15″ W. Nets (4 and 7 mm. mesh) attached to back of trawl, 27–38 m.: 6 specimens, 85–130 mm.

St. WS 835. 2. ii. 32. 53° 05′ 30″ S, 68° 06′ 30″ W. Small beam trawl, 14–16 m.: 14 specimens, 85–145 mm.

No visible scales. Depth of body 7½ to 9½ in the length, length of head 5½ to 6. Diameter of eye 6 to 7 in length of head, about equal to interocular width, greater than interorbital width. Maxillary extending to below posterior part or hinder edge of eye; lower jaw shorter than upper; teeth obtusely conical, those of upper jaw uniserial laterally, bi- or triserial anteriorly, those of lower jaw uniserial, with an inner series of 2 to 4 teeth at the symphysis; no canines in upper jaw, but 1 or 2 teeth on each side of lower jaw enlarged and canine-like; 2 or 3 teeth on the vomer and a single series on each palatine. About 85 rays in the dorsal fin, about 70 in the anal; distance from head to origin of anal about 1½ times length of head. Pectoral about ⅔, pelvic ¼ to ⅓ the length of head. Head, body and fins variegated with dark brown; body with a series of more or less distinct broad dark cross-bars; pectoral spotted and blotched with darker.

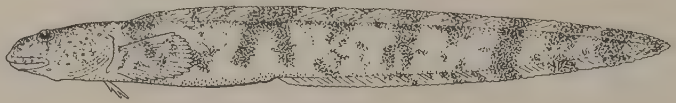

Fig. 51. *Iluocoetes elongatus.* × ¾.

*Hab.* Patagonian-Falklands region.

This species, which was not previously represented in the British Museum collection, is readily distinguished from the preceding by the absence of scales, the smaller head, smaller eye, absence of canine teeth in the upper jaw, greater distance from the head to the origin of the anal fin, and by the coloration.

### Genus **Austrolycus**, Regan

1913, *Trans. R. Soc. Edinb.*, XLIX, p. 245. Type *A. depressiceps*, Regan.

Some scales embedded in the skin. Head depressed; body compressed posteriorly. Mouth subterminal; teeth conical, uniserial at sides of jaws, bi- or triserial anteriorly; a group of teeth on the vomer and a single series on each palatine. Gill-opening cleft downward to middle or lower part of base of pectoral. Dorsal origin just behind head, above base of pectoral; pelvic fins present.

Two species.

**Austrolycus depressiceps**, Regan. "Grongi."

*Lycodes latitans* (*non* Jenyns), Günther, 1862, *Cat. Fish.*, IV, p. 321; Cunningham, 1871, *Trans. Linn. Soc. London*, XXVII, p. 471; Günther, 1881, *Proc. Zool. Soc.*, p. 20; Vaillant, 1888, *Miss. Sci. Cap Horn*, VI. Zool., Poiss., p. 21, pl. iii, fig. 1; Boulenger, 1900, *Ann. Mag. Nat. Hist.* (7) VI, p. 53; Hussakof, 1914, *Bull. Amer. Mus. Nat. Hist.*, XXXIII, p. 91.

*Phucocoetes latitans* (*non* Jenyns), Smitt, 1898, *Bih. Sv. Vet.-Akad. Handl.*, XXIV, IV, No. 5, p. 51, pl. v, figs. 37–39; Garman, 1899, *Mem. Mus. Comp. Zoöl.*, XXIV, p. 138; Delfin, 1901, *Cat. Peces Chile*, p. 97; Lönnberg, 1907, *Hamb. Magalh. Sammelr.*, Fische, p. 12; Lahille, 1908, *Anal. Mus. Nac. B. Aires*, XVI, p. 421, fig. 6.

*Lycodes* (*Phucocoetes*) *latitans* (*non* Jenyns), Steindachner, 1898, *Zool. Jahrb.*, Suppl. IV, p. 318.

*Austrolycus depressiceps*, Regan, 1913, *Trans. R. Soc. Edinb.*, XLIX, pp. 238, 245, pl. V, fig. 1.

Depth of body 9 to 10 in the length, length of head $5\frac{1}{4}$ to $6\frac{1}{2}$. Diameter of eye $6\frac{1}{2}$ to $11\frac{1}{2}$ in length of head, much less than interocular width but nearly equal to interorbital width. Maxillary extending to below hinder edge of eye; lower jaw a little shorter than upper. 100 to 110 rays in the dorsal fin, 70 to 80 in the anal; distance from head to origin of anal $1\frac{3}{4}$ times to twice length of head. Pectoral $\frac{2}{3}$, pelvic $\frac{1}{5}$ to $\frac{1}{4}$ the length of head. Brownish or blackish-grey, abdomen paler; lower surface of head pale yellow; young and half-grown individuals with areas of pale yellow or white on sides of head, on the nape, above end of pectoral, and often on upper parts of sides and on dorsal fin; vent in a yellow or white spot.

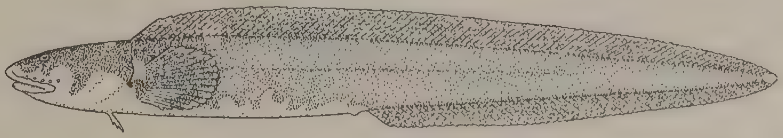

Fig. 52. *Austrolycus depressiceps*. × $\frac{1}{2}$.

*Hab.* Patagonian-Falklands region; Straits of Magellan; Tierra del Fuego; southern Chile.

No specimens of this species were obtained by the Discovery Expedition, but Mr Bennett has sent 13 (50–480 mm.) from Stanley, Falkland Islands, taken from under stones at low water during spring tides from October to December; as well as 6 others (83–152 mm.) collected near the beach at New Island, West Falklands, by Mr Hamilton in February, 1934. There are also 16 specimens (45–290 mm.) in the British Museum collection from the Falklands, Straits of Magellan and Chonos Archipelago. The specimen of 240 mm. collected by Dr Cunningham, which was figured by Regan, may be regarded as the holotype. The species is said to be fairly common under rocks and stones along the shore in the neighbourhood of Stanley, and also in the deep water in Stanley Harbour. Mr Bennett notes that he once saw one of nearly 3 lb. weight. It is known locally as "Eel" or "Rock Eel".

**Austrolycus laticinctus** (Berg).

*Lycodes laticinctus*, Berg, 1895, *Anal. Mus. Nac. B. Aires*, IV, p. 71, pl. i, fig. 2.

*Lycodes* (*Phucocoetes*) *platei*, Steindachner, 1898, *Zool. Jahrb.*, Suppl. IV, p. 320, pl. XIX, fig. 8.

*Phucocoetes variegatus macropus* (part), Smitt, 1898, *Bih. Sv. Vet.-Akad. Handl.*, XXIV, IV, No. 5, p. 44, pl. V, fig. 35.

*Phucocoetes platei*, Delfin, 1901, *Cat. Peces Chile*, p. 98.

? *Lycodalepis morenoi*, Lahille, 1908, *Anal. Mus. Nac. B. Aires*, XVI, p. 413, pl. VI.

*Lycodalepis laticinctus*, Lahille, 1908, *t.c.*, p. 417, figs. 4, 5.

*Austrolycus platei*, Regan, 1913, *Trans. R. Soc. Edinb.*, XLIX, p. 246.

St. WS 749. 18. ix. 31. 52° 39′ 30″ S, 69° 53′ 30″ W. Rectangular net, 40 m.: 4 specimens, 120–155 mm.

Depth of body 9 to 10 in the length, length of head $5\frac{3}{4}$ to 6. Diameter of eye about 7 in length of head, about equal to interocular width. Maxillary extending to below middle of eye; lower jaw distinctly shorter than upper. 100 to 115 rays in the dorsal fin, 75 to 85 in the anal; distance from head to origin of anal $1\frac{1}{3}$ to $1\frac{1}{2}$ times length of head. Pectoral about $\frac{2}{3}$, pelvic $\frac{1}{4}$ to $\frac{1}{3}$ the length of head. Body brownish, with a series of pale areas along upper parts of sides, continued on to the dorsal fin; other irregular pale spots and blotches scattered over lower parts of sides; abdomen and lower parts of head pale; snout and jaws pale yellowish-white, a sharp line separating this colour from the dark brown of the rest of the head, the latter sometimes projecting below the eye as a short bar; a pale area on the nape; pectorals pale, with a large dark area above; pelvics yellowish.

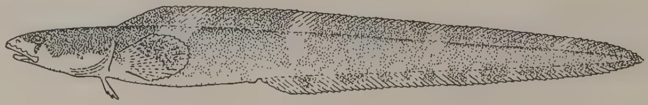

Fig. 53. *Austrolycus laticinctus.* × $\frac{3}{4}$.

*Hab.* Coast of Argentina (?); Patagonian-Falklands region; Tierra del Fuego.

The above specimens agree very well with Berg's description of *Lycodes laticinctus*, the type of which was 155 mm. long and came from Santa Cruz. Steindachner's *Lycodes platei* from the east coast of Tierra del Fuego, the type of which was 234 mm. long, is an undoubted synonym, as is the example from Rio Grande, Tierra del Fuego, described and figured by Smitt (fig. 35) as *Phucocoetes variegatus macropus*. The young example, also identified by Smitt as *P. variegatus macropus* (fig. 36), is, as far as I can judge, a specimen of *Iluocoetes fimbriatus*. *Lycodalepis morenoi*, Lahille, was based upon a single large specimen (620 mm.) from Cape San Antonio (36° 20′ S). The tail appears to be shorter and the coloration somewhat different, but it seems probable that this form represents the same species as that described by Berg.

### Genus **Phucocoetes**, Jenyns

1842, *Zool. 'Beagle'*, Fish., p. 168; Regan, 1913, *Trans. R. Soc. Edinb.*, XLIX, p. 246. Type *P. latitans*, Jenyns.

Some scales embedded in the skin. Head and body compressed. Mouth subterminal; teeth conical, those of upper jaw uniserial laterally, usually with an outer series of enlarged and canine-like teeth anteriorly, those of lower jaw bi- or triserial; teeth on the vomer and in a single series on each palatine; 1 or 2 pairs of teeth in the lower jaw and the middle vomerine teeth more or less enlarged and canine-like. Gill-opening small, above base of pectoral. Dorsal origin just behind head, above base of pectoral; pelvic fins present.

A single species.

### **Phucocoetes latitans**, Jenyns.

*Phucocoetes latitans*, Jenyns, 1842, *Zool. 'Beagle'*, Fish., p. 168, pl. xxix, fig. 3; Regan, 1913, *Trans. R. Soc. Edinb.*, XLIX, p. 246.

*Lycodes flavus*, Boulenger, 1900, *Ann. Mag. Nat. Hist.* (7) VI, p. 53.
*Phucocoetes platei*, Lönnberg, 1907, *Hamb. Magalh. Sammelr.*, Fische, p. 13.

St. WS 749. 18. ix. 31. 52° 39′ 30″ S, 69° 53′ 30″ W. Rectangular net, 40 m.: 2 specimens, 23, 30 mm.

St. WS 847. 9. ii. 32. 50° 15′ 45″ S, 67° 57′ W. Commercial otter trawl, with nets attached, 56–84 m.: 4 specimens, 123–140 mm.

Depth of body 7¾ to 10 in the length, length of head 6½ to 7. Diameter of eye 6 to 8 in length of head, equal to or greater than the interorbital width. Lower jaw included; maxillary extending to below posterior part or hinder edge of eye. About 100 rays in the dorsal fin, about 80 in the anal; distance from head to origin of anal about 1½ times length of head. Pectoral about ⅗, pelvic ¼ to nearly ⅓ the length of head.

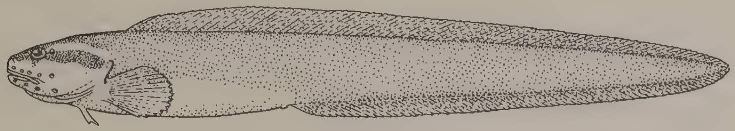

Fig. 54. *Phucocoetes latitans.* × 1.

Brownish; upper part of head dark brown, with a pale yellow band from the eye to the shoulder; lower part of head pale yellowish.

*Hab.* Falkland Islands.

In addition to the above, Mr Bennett has sent 4 specimens (58–92 mm.) from Stanley, Falklands, and there are 5 others (45–115 mm.) in the British Museum collection, including two of the types of the species and the type of *Lycodes flavus*.

Mr Bennett notes that his specimens were secured from among the hollow tangled roots of "kelp" (*Macrocystis*), and the type of *Lycodes flavus* was obtained by Mr Vallentin in exactly the same manner.[1] Two of the specimens collected by the 'William Scoresby' in February, 1932, are females with ripe ova.

### Genus **Crossostomus**, Lahille

*Crossostomus*,[2] Lahille, 1908, *Anal. Mus. Nac. B. Aires*, XVI, p. 408. Type *Lycodes* (*Iluocoetes*) *fimbriatus*, Steindachner *nec* Jenyns.
*Crossolycus*, Regan, 1913, *Trans. R. Soc. Edinb.*, XLIX, p. 247. Type *C. chilensis*, Regan [= *Lycodes* (*Iluocoetes*) *fimbriatus*, Steindachner *nec* Jenyns].

Scales embedded in the skin. Body elongate, compressed. Snout and lower jaw with fringes. Mouth subterminal; teeth in jaws conical, bi- or triserial; lower jaw with a posterior canine; palate toothless. Gill-opening almost entirely above base of pectoral. Dorsal origin just behind head, above or a little in advance of base of pectoral; pelvic fins present.

Two species.

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[1] This appears to be the normal habitat of the species.

[2] Not to be confused with *Crossostoma*, which has been used as a generic name in the Mollusca (1850), in the Vermes (1854), in the Coelenterata (1862), and in the Pisces (1878).

### **Crossostomus chilensis** (Regan).

*Lycodes* (*Iluocoetes*) *fimbriatus* (*non* Jenyns), Steindachner, 1898, *Zool. Jahrb.*, Suppl. IV, p. 322, pl. xx, fig. 10.
*Crossostomus fimbriatus*, Lahille, 1908, *Anal. Mus. Nac. B. Aires*, XVI, p. 410.
*Crossolycus chilensis*, Regan, 1913, *Trans. R. Soc. Edinb.*, XLIX, p. 247.

Depth of body equal to length of head and $6\frac{3}{5}$ in that of fish. Diameter of eye 7 in length of head, equal to interorbital width. Lips thick. 80 rays in the dorsal fin, 60 in the anal; distance from head to origin of anal $1\frac{1}{2}$ times length of head. Pectoral $\frac{2}{3}$ the length of head. Head, body and dorsal fin marbled with brown.

*Hab.* Tierra del Fuego.

Known only from the unique holotype, 252 mm. in total length, from Cape Espiritu Santo, east coast of Tierra del Fuego.

### **Crossostomus fasciatus** (Lönnberg).

*Iluocoetes fimbriatus fasciatus*, Lönnberg, 1905, *Wiss. Ergebn. Schwed. Südpol.-Exped.*, v (6), p. 20.
*Crossolycus fasciatus*, Regan, 1913, *Trans. R. Soc. Edinb.*, XLIX, p. 247.

Depth of body $7\frac{1}{2}$ in the length, length of head 5. Diameter of eye $5\frac{3}{5}$ in length of head, equal to interorbital width. Distance from head to origin of anal fin $1\frac{1}{3}$ times length of head. Pectoral a little more than $\frac{1}{2}$ length of head. Dark brown, with 5 or 6 whitish transverse bars.

*Hab.* Falkland Islands.

Known only from the unique holotype, 74 mm. in total length.

I have followed Regan in placing this fish in this genus, but it seems possible that re-examination of the type will show that it is a young example of *Austrolycus depressiceps*.

### Genus **Pogonolycus**, nov.

Type *P. elegans*, sp.n.

Scales embedded in the skin. Body elongate, compressed. Snout and lower jaw with numerous small dermal tentacles. Mouth terminal; teeth conical, in several rows in both jaws, those of the outer series somewhat enlarged; 1 or 2 enlarged canine-like teeth on each side of lower jaw; a group of teeth on the vomer and 2 rows on each palatine. Gill-opening cleft downward to middle of base of pectoral. Dorsal origin just behind head, above anterior part of pectoral; pelvic fins present.

### **Pogonolycus elegans**, sp.n. (Plate I, fig. 3).

St. WS 97. 18. iv. 27. 49° 00′ 30″ S, 61° 58′ W. Commercial otter trawl, 146–145 m.: 1 specimen, 43 mm.

St. WS 246. 19. vii. 28. 52° 25′ S, 61° 00′ W. Nets (4 and 7 mm. mesh) attached to back of trawl, 267–208 m.: 1 specimen, 158 mm. Holotype.

St. WS 749. 18. ix. 31. 52° 39′ 30″ S, 69° 53′ 30″ W. Rectangular net, 40 m.: 1 specimen, 21 mm.

St. WS 878. 4. iv. 32. 52° 36′ S, 58° 54′ W. Rectangular net, 121 (–0) m.: 2 specimens, 62, 63 mm.

Depth of body $8\frac{1}{2}$ to $9\frac{1}{2}$ in the length, length of head $5\frac{1}{4}$ (young) to $6\frac{3}{4}$. Diameter of eye $4\frac{1}{2}$ (young) to $5\frac{1}{2}$ in length of head, about equal to interorbital width. Maxillary extending about to below middle of eye; jaws equal anteriorly. About 75 rays in the dorsal fin, about 60 in the anal; distance from head to origin of anal about 1⅓ times length of head. Pectoral about ½, pelvic ⅕ to ¼ the length of head. Pale yellowish, with a broad brown lateral stripe, edged with darker brown, and a similar but interrupted band along the middle of the back, extending on to the dorsal fin, the three bands uniting on the upper surface of the head; a narrow brown vertical streak below the eye; anal and pectoral fins yellowish.

*Hab.* Patagonian-Falklands region.

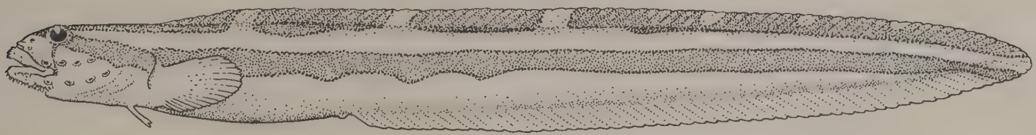

Fig. 55. *Pogonolycus elegans.* Holotype. × 1.

The specimen sketched in water-colours by Mr E. R. Gunther (St. WS 97) had been in formalin for several days, but its colours did not appear to have altered. It was brought up in the trawl among colonies of *Cephalodiscus.*

### Genus **Platea**, Steindachner

1898, *Zool. Jahrb.*, Suppl. IV, p. 323; Regan, 1913, *Trans. R. Soc. Edinb.*, XLIX, p. 247. Type *P. insignis*, Steindachner.

Skin naked. Body elongate, compressed. Snout and lower jaw with dermal processes. Mouth subterminal; teeth incisor-like, uniserial in both jaws; palate toothless. Gill-opening cleft downward to middle of base of pectoral. Dorsal origin just behind head, above anterior part of pectoral; pelvic fins present.

A single species.

**Platea insignis**, Steindachner.

*Platea insignis*, Steindachner, 1898, *Zool. Jahrb.*, Suppl. IV, p. 323, pl. XX, fig. 12; Delfin, 1901, *Cat. Peces Chile*, p. 98; Regan, 1913, *Trans. R. Soc. Edinb.*, XLIX, p. 248; Hussakof, 1914, *Bull. Amer. Mus. Nat. Hist.*, XXXIII, p. 91; Thompson, 1916, *Proc. U.S. Nat. Mus.*, L, p. 417.

St. WS 749. 18. ix. 31. 52° 39′ 30″ S, 69° 53′ 30″ W. Rectangular net, 40 m.: 6 specimens, 83–180 mm.

St. WS 835. 2. ii. 32. 53° 05′ 30″ S, 68° 06′ 30″ W. Small beam trawl, 14–16 m.: 8 specimens, 110–140 mm.

Depth of body 11½ to 14½ in the length, length of head 7 to 7½. Diameter of eye 6 to 7 in length of head, greater than interorbital width. Lower jaw more or less included; maxillary extending to below middle of eye. About 100 to 110 rays in the dorsal fin, about 90 to 100 in the anal; distance from head to origin of anal about 1½ times length

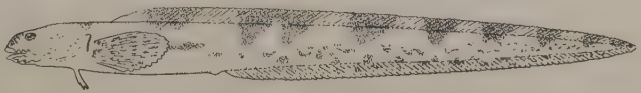

Fig. 56. *Platea insignis.* × ½.

of head. Pectoral nearly as long as head, pelvic about $\frac{1}{3}$ the length of head. Pale brownish, the head, body and fins spotted and variegated with darker, a row of dark saddle-like blotches along the back being most prominent.

*Hab.* Coast of Argentina; Patagonian-Falklands region; Tierra del Fuego.

The type of the species, which is 265 mm. in total length, is from Cape Espiritu Santo, east coast of Tierra del Fuego. The species is new to the British Museum collection.

### Genus **Maynea**, Cunningham

1871, *Trans. Linn. Soc. London*, XXVII, p. 471; Regan, 1913, *Trans. R. Soc. Edinb.*, XLIX, p. 248. Type *M. patagonica*, Cunningham.

*Gymnelichthys*, Fischer, 1885, *Jahrb. Hamb. Wiss. Anst.*, II, p. 60. Type *G. antarcticus*, Fischer.

Body elongate or rather short, compressed. Mouth terminal; teeth conical, uniserial in both jaws and on vomer and palatines. Gill-opening cleft downward to or nearly to middle of base of pectoral. Dorsal origin just behind head, above base of pectoral; no pelvic fins.

Three species: two from the Patagonian region, one from South Georgia.

**Maynea patagonica**, Cunningham.

*Maynea patagonica*, Cunningham, 1871, *Trans. Linn. Soc. London*, XXVII, p. 472; Günther, 1881, *Proc. Zool. Soc.*, p. 20, pl. ii, figs. C, D; Perugia, 1891, *Ann. Mus. Civ. stor. nat. Genova* (2) X [XXX], p. 624; Steindachner, 1898, *Zool. Jahrb.*, Suppl. IV, p. 318; Delfin, 1901, *Cat. Peces Chile*, p. 96; Lönnberg, 1905, *Wiss. Ergebn. Schwed. Südpol.-Exped.*, V (6), p. 8; Lahille, 1908, *Anal. Mus. Nac. B. Aires*, XVI, p. 439, fig. 8; Regan, 1913, *Trans. R. Soc. Edinb.*, XLIX, p. 248; Hussakof, 1914, *Bull. Amer. Mus. Nat. Hist.*, XXXIII, p. 92.

Small scales embedded in the skin. Depth of body 10 to $12\frac{1}{2}$ in the length, length of head $6\frac{2}{3}$ to $7\frac{1}{3}$. Diameter of eye 5 to 6 in length of head, much greater than interorbital width. Maxillary extending to below anterior $\frac{1}{3}$ or middle of eye; teeth all small, more or less equal in size, scarcely curved. About 120 rays in the dorsal fin, about 95 in the anal; distance from head to origin of anal $1\frac{2}{3}$ to $1\frac{4}{5}$ in length of head. Pectoral less than $\frac{1}{2}$ the length of head. Yellowish, with broad brown cross-bars separated by narrow interspaces.

*Hab.* Patagonian-Falklands region; Straits of Magellan; Tierra del Fuego.

No specimens of this species were obtained by the Discovery Expedition, but there are two in the British Museum collection: the holotype (150 mm.) from the Otter Islands, and another (90 mm.) from the Straits of Magellan.

**Maynea brevis**, sp.n.

St. WS 216. 1. vi. 28. 47° 37′ S, 60° 50′ W. Net (7 mm. mesh) attached to back of trawl, 219–133 m.: 1 specimen, 44 mm.

St. WS 244. 18. vii. 28. 50° 00′ S, 62° 40′ W. Net (7 mm. mesh) attached to back of trawl, 253–247 m.: 1 specimen, 43 mm.

St. WS 784. 5. xii. 31. 49° 47′ 45″ S, 61° 05′ W. Seine net attached to back of trawl, 170–164 m.: 1 specimen, 68 mm.

St. WS 825. 28–29. i. 32. 50° 50′ S, 57° 15′ 15″ W. Commercial otter trawl, with net (7 mm. mesh) attached, 135–144 m.: 1 specimen, 90 mm. Holotype.

Skin rather loose, naked. Depth of body 6 to 7 in the length, length of head 4 to $4\frac{3}{4}$. Diameter of eye 4 to $4\frac{3}{4}$ in length of head, equal to or greater than interorbital width. In the two larger specimens the snout and lower jaw, as well as the opercular region, are provided with broad dermal processes, of which one above each eye is most prominent and is present also in the smaller specimens. Maxillary extending to below middle or posterior part of eye; teeth strong, pointed, curved, more or less unequal in size, those on the vomer and palatines larger than those in the jaws. About 65 rays in the dorsal fin, about 55 in the anal; distance from head to origin of anal equal to or a little less than length of head. Pectoral $\frac{3}{5}$ to $\frac{2}{3}$ the length of head. Head, body and fins spotted and variegated with dark brown; some short cross-bars directed obliquely forward on upper parts of sides; 2 broad dark bars below the eye, another from the eye to the edge of the praeoperculum, and usually another between the anterior parts of the eyes; dorsal and anal fins sometimes with a row of brown spots; pectoral uniformly yellowish or with small brown spots.

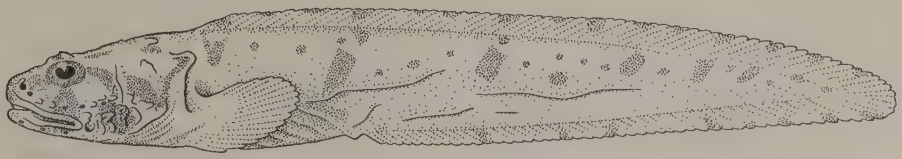

Fig. 57. *Maynea brevis*. Holotype. × $1\frac{1}{2}$.

*Hab.* Patagonian-Falklands region.

It is possible that this species should be placed in a genus distinct from *Maynea*, as it differs from *M. patagonica* and *M. antarctica* in the much shorter body, fewer fin-rays, loose, naked skin, as well as in the presence of dermal processes on the head. The teeth are also stronger, and in this character *M. brevis* approaches the genus *Melanostigma*.

## Genus Melanostigma, Günther

1881, *Proc. Zool. Soc.*, p. 21; Regan, 1913, *Trans. R. Soc. Edinb.*, XLIX, p. 248. Type *M. gelatinosum*, Günther.

Skin naked. Body compressed, elongate. Mouth terminal; teeth uniserial in both jaws and on vomer and palatines. Gill-opening small, above base of pectoral. Dorsal origin just behind head; no pelvic fins.

Several species from deep water in the Atlantic and Pacific: two from the Patagonian region.

### Melanostigma gelatinosum, Günther.

*Melanostigma gelatinosum*, Günther, 1881, *Proc. Zool. Soc.*, p. 21, pl. ii, fig. A; Regan, 1913, *Trans. R. Soc. Edinb.*, XLIX, p. 248.

Skin loose. Depth of body about 10 in the length, length of head 6. Diameter of eye $3\frac{1}{3}$, interorbital width about 12 in length of head. Mouth oblique; maxillary extending to below middle of eye; a patch of teeth on the vomer, the middle teeth larger. Distance from head to origin of anal equal to length of head. Pectoral nearly

½ length of head. Sides spotted and marbled with purplish-grey; end of tail blackish; inside of mouth, gill-opening and vent black.

*Hab.* Straits of Magellan, 24 fathoms.

Known only from the unique holotype, 140 mm. in total length.

**Melanostigma microphthalmus, sp.n.**

St. WS 246. 19. vii. 28. 52° 25′ S, 61° 00′ W. Commercial otter trawl, 267–208 m.: 1 specimen, 70 mm.

St. WS 248. 20. vii. 28. 52° 40′ S, 58° 30′ W. Commercial otter trawl, 210–242 m.: 1 specimen, 85 mm. Holotype.

Skin not loose. Depth of body about 10 in the length, length of head 6½ to nearly 7. Diameter of eye about 5½ in length of head, greater than interorbital width. Mouth nearly horizontal; maxillary extending to below anterior part or middle of eye; no canines in upper jaw, but an enlarged canine-like tooth on each side of lower jaw; a pair of teeth placed side-by-side on the vomer. Distance from head to origin of anal greater than length of head. Pectoral about ½ length of head. Back and sides brownish; abdomen and lower parts of head pale yellowish-white, spotted or marbled with brown; in the holotype the pale colour of the abdomen extends posteriorly along lower part of side; median fins pale yellowish-white, with some irregular brown markings; pectorals yellowish; inside of mouth and gill-opening pale.

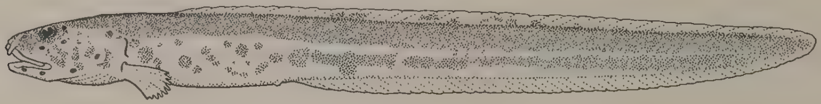

Fig. 58. *Melanostigma microphthalmus.* × 1½.

*Hab.* Just south of the Falkland Islands.

## LYCODAPODIDAE

There is some doubt whether this family can be maintained as distinct from the Zoarcidae, to which it is very closely allied. I have ascertained that in *Lycodapus australis* the basal bones of the dorsal and anal fins are equal in number to the neural and haemal spines. Regan (1912, *Ann. Mag. Nat. Hist.*, Ser. 8, x, p. 276) has pointed out that "the head and mouth [of *Lycodapus*] recall those of *Lycodopsis* or *Bothrocara*, the gill-membranes join the isthmus between the rami of the lower jaw (at least in *L. fierasfer*), and the dorsal and anal rays correspond in number to the myotomes".

**Lycodapus australis, sp.n.**

St. WS 748. 16. ix. 31. 53° 41′ 30″ S, 70° 55′ W. Rectangular net, 300 m.: 4 specimens, 50–93 mm. (holotype, 93 mm.).

Depth of body 11½ to nearly 12 in the length, length of head 6¼ to 6¾. Snout about 1½ times as long as eye, diameter of which is 4½ in length of head and greater than interorbital width. Lower jaw a little longer than upper; maxillary extending to below anterior part or middle of eye; teeth small, curved, in broad bands in both jaws, the bands tapering posteriorly; teeth of the outer row a little larger and set nearly horizontally; many of the teeth visible when the mouth is closed; a transverse series of 3 to 6 similar teeth on the vomer and a row of 10 to 15 on each palatine. Gill-opening extending well above base of pectoral; no pseudobranchiae; gill-rakers longer than broad, 10 on lower part of anterior arch; gill-membranes united anteriorly and free from the isthmus. Dorsal 82–85; origin above middle of pectoral. Anal about 75; distance from head to origin of fin about equal to length of head. Pectoral $2\frac{3}{5}$ to 3 in length of head. Skin loose; mucous pores on head rather inconspicuous; an irregular double row of mucous pores along anterior part of side, rising anteriorly above the pectoral fin, becoming single and eventually disappearing posteriorly. Uniformly brownish; head paler; fins yellowish-brown.

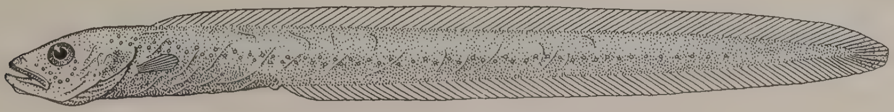

Fig. 59. *Lycodapus australis*. Holotype. × $1\frac{1}{2}$.

*Hab.* Straits of Magellan.

All the previously known species of this genus are from the Pacific coast of North America, ranging from the Bering Sea to Lower California. In the conspicuous mucous pores on the body this species resembles *L. dermatinus*, Gilbert, but differs in the dentition, greater number of dorsal and anal rays, smaller head, rather more slender body, etc. A related genus, *Snyderidea*, Gilbert, with canine-like teeth in the jaws and on the vomer and palatines, has been described from the Hawaiian Islands.

## OPHIDIIDAE

### Genus **Genypterus**, Philippi

1857, *Arch. Naturgesch.*, XXIII (1), p. 268. Type *G. nigricans*, Philippi.

### *Key to the South American species*

I. Depth of body $6\frac{2}{3}$ to $9\frac{1}{2}$, head $4\frac{1}{2}$ to 5 in length of fish; interorbital width $6\frac{1}{2}$ to $8\frac{1}{2}$ in length of head.
  A. Depth of body $7\frac{1}{2}$ to $9\frac{1}{2}$ in length of fish; eye 5 to 7 (very large specimens) in length of head; coloration yellowish, the back and upper parts of sides marbled with brown ... ... ... ... ... ... ... ... ... ... ... *blacodes*.
  B. Depth of body $6\frac{2}{3}$ to $7\frac{1}{2}$ in length of fish; eye 7 to $7\frac{3}{4}$ in length of head; back and upper parts of sides blackish, with some rather small and irregularly arranged white spots ... ... ... ... ... ... ... ... ... ... ... *chilensis*.

II. Depth of body 6 to $6\frac{1}{4}$, head about 4 in length of fish; interorbital width about $5\frac{1}{2}$ in length of head; whole body chocolate brown or blackish, covered with large white hieroglyphic-like markings ... ... ... ... ... ... ... ... ... ... *maculatus*.

**Genypterus blacodes (Schneider).** "Abadejo"; "Ymakara" or "Himakhara".

*Ophidium blacodes*, Schneider, 1801, in Bloch, *Syst. Ichth.*, p. 484.

*Genypterus blacodes*, Hutton and Hector, 1872, *Fish. N. Zealand*, pp. 48, 116, pl. viii, fig. 77; Perugia, 1891, *Ann. Mus. Civ. stor. nat. Genova* (2) X [XXX], p. 628; Berg, 1895, *Anal. Mus. Nac. B. Aires*, IV, p. 72; Regan, 1903, *Ann. Mag. Nat. Hist.* (7) XI, p. 600; Lönnberg, 1905, *Wiss. Ergebn. Schwed. Südpol.-Exped.*, V (6), p. 9, pl. ii, fig. 6; McCulloch, 1914, *Biol. Res. 'Endeavour'*, II, p. 158; Devincenzi, 1924, *Anal. Mus. Montevideo* (II) I (5), p. 275; Phillipps, 1927, *N. Zealand Mar. Dept. Fish. Bull.*, I, p. 52; McCulloch, 1929, *Mem. Austral. Mus.*, V, p. 357.

*Genypterus tigerinus*, Klunzinger, 1872, *Arch. Naturgesch.*, XXVIII (I), p. 39.

*Genypterus australis*, Castelnau, 1872, *Proc. Zool. Acclim. Soc. Victoria*, I, p. 164.

? *Genypterus chilensis*, Vaillant, 1888, *Miss. Sci. Cap Horn*, VI. Zool., Poiss., p. 19.

*Genypterus capensis*, Berg, 1898, *Comun. Mus. Nac. B. Aires*, I, p. 13; Berg, 1899, *t.c.*, p. 97.

? *Genypterus microstomus*, Regan, 1903, *Ann. Mag. Nat. Hist.* (7) XI, p. 599; McCulloch, 1914, *Biol. Res. 'Endeavour'*, II, p. 159, pl. xiv, fig. 2; Devincenzi, 1924, *Anal. Mus. Montevideo* (II) I (5), p. 275.

St. WS 79. 13. iii. 27. 51° 01′ 30″ S, 64° 59′ 30″ W. Commercial otter trawl, 132–131 m.: 2 specimens, 350, 430 mm.

St. WS 80. 14. iii. 27. 50° 57′ S, 63° 37′ 30″ W. Commercial otter trawl, 152–151 m.: 3 specimens, 400–480 mm.

St. WS 216. 1. vi. 28. 47° 37′ S, 60° 50′ W. Commercial otter trawl, 219–133 m.: 1 specimen, 450 mm.

St. WS 217. 1. vi. 28. 46° 28′ S, 60° 18′ W. Commercial otter trawl, 146 m.: 1 specimen, 820 mm.

St. WS 763. 16. x. 31. 44° 14′ S, 63° 28′ W. Seine net attached to back of trawl, 87–82 m.: 1 specimen, 190 mm.

St. WS 789. 13. xii. 31. 45° 17′ S, 64° 22′ W. Seine net attached to back of trawl, 95–93 m.: 5 specimens, 190–350 mm.

St. WS 816. 14. i. 32. 52° 09′ 45″ S, 64° 56′ W. Commercial otter trawl, 150 m.: 1 specimen, 960 mm.

Depth of body $7\frac{1}{2}$ to $9\frac{1}{2}$ in the length, length of head $4\frac{1}{2}$ to 5. Snout as long as or longer than eye, diameter of which is 5 (young) to 7 (large specimens) in length of head; interorbital width $6\frac{1}{2}$ to $8\frac{1}{2}$. Maxillary extending to below hinder edge of eye or beyond, the width of its distal extremity nearly equal to diameter of eye. Gill-rakers about $\frac{1}{2}$ as long as eye; 4 (+ rudiments) on lower part of anterior arch. 11 to 15 rows of scales between anterior rays of dorsal fin and the lateral line. Dorsal commencing above middle of pectoral, the length of which is $2\frac{1}{4}$ to $2\frac{2}{3}$ in that of head; longest pelvic ray about $\frac{2}{5}$ length of head. Yellowish; upper parts of sides marbled with brown, the darker markings sometimes rather indistinct; vertical fins with a continuous broad brown longitudinal band, sometimes somewhat indistinct and diffuse, and with pale margins.

*Hab.* Australia and New Zealand; coasts of south-eastern South America from Uruguay to the Straits of Magellan.

I am unable to detect any important differences between the specimens collected by the 'William Scoresby' in the Patagonian-Falklands region and 9 specimens (260–900 mm.) in the British Museum collection from Australia and New Zealand. It seems probable that the examination of a larger series of examples will show that *G. microstomus*, Regan, cannot be maintained as a distinct species, but, if it should prove to be distinct, this form occurs also in the Argentina-Patagonian-Falklands region. McCulloch (1914) has pointed out that the size of the mouth as measured by the position of the hinder edge of the maxillary in relation to the eye is not a reliable character, and, apart from the very slightly larger scales and the coloration, there appear to be no essential differences between the two forms.

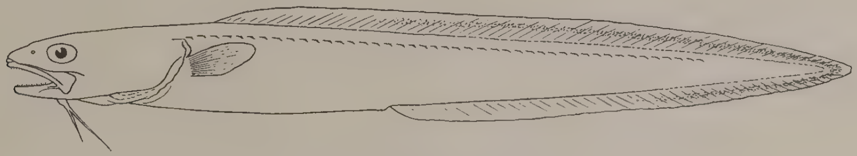

Fig. 60. *Genypterus blacodes.* × $\frac{2}{5}$.

*Genypterus blacodes* is very close to *G. capensis*, and, as suggested by Barnard, the two species may eventually have to be united. If examples of similar size are compared, however, *G. capensis* seems to have a larger eye, the diameter of which is 5½ to 6 (in specimens of 440–480 mm.) or 7 or more (in large specimens) in the length of the head; the interorbital width is somewhat narrower, being 7½ to 8½ in the length of the head; the markings on the body are much less conspicuous, and the brown band on the vertical fins is rather broader and more diffuse.

**Genypterus chilensis** (Guichenot). "Congrio colorado."

*Conger chilensis*, Guichenot, 1848–9, in Gay, *Hist. Chile*, Zool. II, p. 339.

*Genypterus blacodes*, Günther, 1862, *Cat. Fish.*, IV, p. 380; Delfin, 1903, *Revist. Chil.*, VII, p. 37, pl. xiii, fig. 2; Thompson, 1916, *Proc. U.S. Nat. Mus.*, L, p. 469; Evermann and Radcliffe, 1917, *Bull. U.S. Nat. Mus.*, XCV, p. 149.

*Genypterus chilensis*, Günther, 1862, *Cat. Fish.*, IV, p. 380; Günther, 1880, *Shore Fish. 'Challenger'*, p. 25; Regan, 1903, *Ann. Mag. Nat. Hist.* (7) XI, p. 600.

Depth of body 6⅔ to 7½ in the length, length of head 4½ to 4¾. Snout longer than eye, diameter of which is 7 to 7¾ in length of head; interorbital width about 7. Maxillary extending to well beyond eye. Length of pectoral about 2¼ in that of head. Back and upper parts of sides blackish, with some rather small and irregularly arranged white spots; lower parts abruptly yellowish.

*Hab.* Coasts of Chile and Peru.

There are 3 specimens (355–580 mm.) in the British Museum collection: 2 from Concepcion, received from Mr Cavendish Bentinck; and 1 from Valparaiso, collected by the 'Challenger' Expedition. A young specimen (130 mm.), also from Valparaiso, seems to belong here.

This species is closely related to *G. blacodes*, but the body is deeper, the eye smaller, and the coloration different.

**Genypterus maculatus** (Tschudi). "Congrio negro."

*Ophidium blancodes*, Tschudi, 1846, *Fauna Peru.*, Ichth., p. 29.

*Ophidium maculatum*, Tschudi, 1846, *t.c.*, p. 29, pl. v.

*Genypterus nigricans*, Philippi, 1857, *Arch. Naturgesch.*, XXIII (1), p. 269.

*Genypterus maculatus*, Regan, 1903, *Ann. Mag. Nat. Hist.* (7) XI, p. 600.

*Genypterus chilensis*, Delfin, 1903, *Revist. Chil.*, VII, p. 35, pl. xiii, fig. 1; Evermann and Radcliffe, *Bull. U.S. Nat. Mus.*, XCV, p. 150.

Depth of body 6 to 6¼ in the length, length of head about 4. Snout longer than eye, diameter of which is 7½ to nearly 8 in length of head; interorbital width about 5½. Maxillary extending to well beyond eye. Length of pectoral about twice in that of head. Back and sides as well as lower parts and the greater part of the abdomen chocolate brown or blackish, with conspicuous hieroglyphic-like white markings over the whole of the body and the fins; posterior part of pectoral with a narrow white border.

*Hab.* Coasts of Chile and Peru.

There are 3 specimens (290–480 mm.) in the British Museum collection from Chile, 2 of them received from Mr Cavendish Bentinck.

Many writers on Chilean and Peruvian fishes have identified the "Congrio negro" as *G. chilensis*, and the "Congrio colorado" as *G. blacodes*. There appears to be little doubt that the form with a short body, broad interorbital region, rather long and pointed pectoral fin, and with the large and characteristic white markings, is that figured by Tschudi as *Ophidium maculatum*, but this is usually identified with *Conger chilensis* of Guichenot. The latter is inadequately described to enable the fish to be identified with certainty, but the description seems to apply more nearly to the "Congrio colorado", and, pending a re-examination of the type, the name *chilensis* may be used for this species. *G. nigricans*, Philippi, is almost certainly identical with *G. maculatus*. Owing to the confusion between the two Chilean and Peruvian species it has proved impossible to give full synonymies of these.

## BROTULIDAE

**Cataetyx messieri** (Günther).

*Sirembo messieri*, Günther, 1878, *Ann. Mag. Nat. Hist.* (5) II, p. 19.

*Cataetyx messieri*, Günther, 1887, *Deep-Sea Fish. 'Challenger'*, p. 104, pl. xxiii, fig. B; Goode and Bean, 1895, *Ocean. Ichth.*, p. 318, fig.; Barnard, 1927, *Ann. S. Afric. Mus.*, XXI, p. 877.

St. WS 248. 20. vii. 28. 52° 40′ S, 58° 30′ W. Commercial otter trawl, 210–242 m.: 1 specimen, 145 mm.

St. WS 773. 31. x. 31. 47° 28′ S, 60° 51′ W. Commercial otter trawl, 291–296 m.: 1 specimen, 230 mm.

*Hab.* Patagonian-Falklands region; Messier Channel, Chile; South Africa.

The type is about 200 mm. in total length.

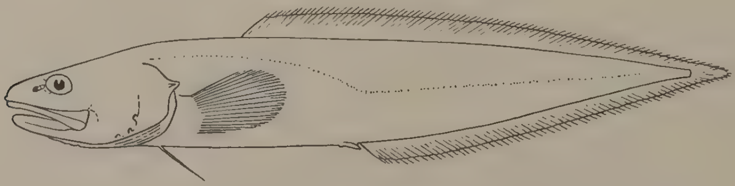

Fig. 61. *Cataetyx messieri.* × ½.

Both the above specimens are males and both have the curious anal papilla described by Gilchrist[1] in a large specimen from South Africa, believed by him to be a copulatory organ of some kind.

## CENTROLOPHIDAE

**Seriolella porosa**, Guichenot. "Cojinova"; "Lacarh'" or "Lassarh'".

1848–9, in Gay, *Hist. Chile*, Zool. II, p. 239, pl. vii, fig. 2; Günther, 1860, *Cat. Fish.*, II, p. 467; Hutton, 1875, *Trans. N. Zeal. Inst.*, VIII, p. 211; Vaillant, 1888, *Miss. Sci. Cap Horn*, VI. Zool., Poiss., p. 29; Berg, 1895, *Anal. Mus. Nac. B. Aires*, IV, p. 35; Delfin, 1901, *Cat. Peces Chile*, p. 52; Regan, 1902, *Ann. Mag. Nat. Hist.* (7) X, p. 128.

*Neptonemus dobula*, Günther, 1869, *Proc. Zool. Soc.*, p. 429.

*Seriolella dobula*, McCulloch, 1929, *Mem. Austral. Mus.*, V, p. 124.

St. WS 853. 21. iii. 32. 44° 39′ 45″ S, 64° 13′ 30″ W. Commercial otter trawl, 90–90 m.: 6 specimens, 365–390 mm.

Depth of body 4 to $4\frac{1}{2}$ in the length, length of head $3\frac{1}{2}$ to 4. Snout longer than eye, diameter of which is 4 to 5 in length of head; interorbital width about 3 times. Maxillary slipping under the praeorbital for the entire length of its upper edge, extending to below anterior margin of eye. Opercular bones not scaled; praeopercular margin with minute denticulations or entire; angle of praeoperculum forming a distinct rounded lobe. About 14 gill-rakers on lower part of anterior arch. Lateral line running high, concurrent with the dorsal profile. Dorsal VII–VIII, I 37–40; the third, fourth and fifth spines longest, equal to $\frac{1}{2}$ to $\frac{2}{3}$ the diameter of the eye; the anterior soft rays about $\frac{2}{5}$ the length of head. Anal III 23–26; the first two spines short and somewhat detached from the rest of the fin. Pectoral nearly as long as head; pelvics inserted behind pectorals, length $2\frac{1}{2}$ to $2\frac{2}{3}$ in that of head.

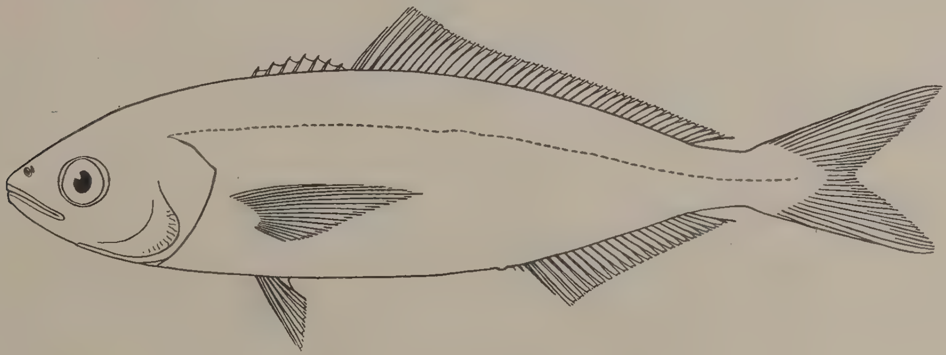

Fig. 62. *Seriolella porosa*. × $\frac{3}{8}$.

*Hab.* Atlantic and Pacific coasts of Patagonia; Chile; coasts of Australia and New Zealand.

I am unable to detect any important differences between the above specimens and several specimens from Tasmania in the British Museum collection, and conclude that

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[1] 1904, *Mar. Invest. S. Africa*, III, p. 141.

*S. dobula* is identical with *S. porosa.* *S. punctata* (Schneider), of which *S. bilineata* (Hutton) is a synonym, is very closely related. *S. brama* (Günther), from Australia and New Zealand, has a deeper body and only 27 to 31 soft rays in the dorsal fin. Other species of *Seriolella* are: *S. violacea*, Guichenot, from Chile; *S. amplus*, Griffin, from New Zealand; *S. velaini*, Sauvage, from the Island of St Paul; and *S. antarctica* (Carmichael), from Tristan da Cunha.[1]

### Palinurichthys caeruleus (Guichenot).

*Seriolella caerulea*, Guichenot, 1848–9, in Gay, *Hist. Chile*, Zool. II, p. 242.

St. WS 97. 18. iv. 27. 49° 00′ 30″ S, 61° 58′ W. Commercial otter trawl, 146–145 m.: 1 specimen, 315 mm.

St. WS 816. 14. i. 32. 52° 09′ 45″ S, 64° 56′ W. Commercial otter trawl, 150 m.: 1 specimen, 320 mm.

Depth of body $2\frac{2}{5}$ to $2\frac{3}{5}$ in the length, length of head $3\frac{1}{2}$ to $3\frac{2}{3}$. Snout as long as or a little shorter than eye, diameter of which is $3\frac{2}{3}$ to 4 in length of head; interorbital width about $3\frac{1}{4}$. Maxillary more or less exposed, extending to below anterior part of eye. Operculum, suboperculum and interoperculum scaled; margin of praeoperculum feebly denticulated. About 14 gill-rakers on lower part of anterior arch. About 95 scales in the lateral line, which does not become straight until it reaches the caudal peduncle. Dorsal VIII–IX 31–32(?). Anal III 20–21(?). Pectoral as long as or nearly as long as head; pelvics inserted distinctly behind pectorals, length about twice in that of head.

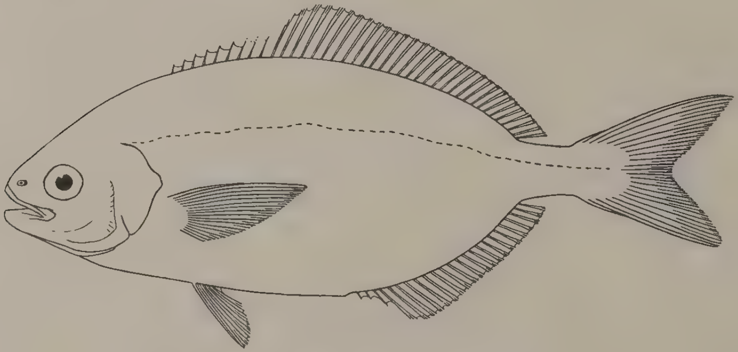

Fig. 63. *Palinurichthys caeruleus.* $\times \frac{1}{3}$.

*Hab.* Patagonian-Falklands region; Juan Fernandez.

It is with some doubt that I have identified these specimens with Guichenot's species, as the original description is a poor one and Mr Chabanaud informs me that the type is not to be found in the Paris Museum. Regan (1902, *Ann. Mag. Nat. Hist.*, Ser. 7, X, p. 128) has suggested that this species does not belong to the genus *Seriolella*, "and may be a *Lirus*".

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[1] I am greatly indebted to Mr P. Chabanaud for photographs of the type specimens of *S. porosa* and *S. violacea* in the Paris Museum.

**Palinurichthys griseolineatus, sp.n.**

St. WS 97. 18. iv. 27. 49° 00′ 30″ S, 61° 58′ W. Commercial otter trawl, 146–145 m.: 1 specimen, 248 mm. Holotype.

St. WS 108. 25. iv. 27. 48° 30′ 45″ S, 63° 33′ 45″ W. Commercial otter trawl, 118–120 m.: 1 specimen, 245 mm.

Depth of body 2⅕ in the length, length of head 3½ to nearly 4. Snout a little shorter than eye, diameter of which is about 3⅔ in length of head; interorbital width 2¾ to 3. Maxillary more or less exposed, extending to below anterior part of eye. Operculum, suboperculum and interoperculum scaled; margin of praeoperculum denticulated. Gill-rakers nearly as long as the gill-filaments, about 15 on lower part of anterior arch. Scales small; lateral line not becoming straight until it reaches the caudal peduncle. Dorsal VII 32–33; fourth and seventh spines apparently longest. Anal III 21. Pectoral nearly as long as head; pelvics inserted behind pectorals, length about 1½ in that of head. Brownish above, silvery yellow below; sides of body with irregular greyish longitudinal stripes; dorsal, anal, pelvics, and the distal parts of the caudal and pectorals blackish.

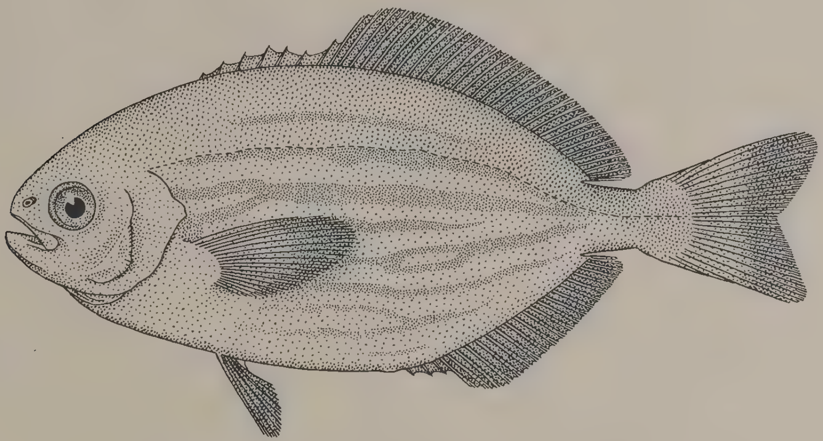

Fig. 64. *Palinurichthys griseolineatus*. Holotype. ×½.

*Hab.* Off the Atlantic coast of Patagonia.

Apparently related to *P. perciformis* (Mitchill) and *P. porosus* (Richardson), differing from both in the greater number of dorsal and anal rays, deeper body, smaller head, longer pectorals, etc.

The two species described above are somewhat tentatively placed in the genus *Palinurichthys*, Bleeker [= *Pammelas*, Günther], as the genera of Centrolophidae are badly in need of further revision. That the genus *Leirus* as defined by Regan (1902, *Ann. Mag. Nat. Hist.*, Ser. 7, x, p. 195) is capable of subdivision cannot be denied, but without an extensive and well-preserved series of specimens of the different species it is almost impossible to define the limits of the various groups. The changes undergone by many of the species of this family during growth are marked, and the material in the National collection is quite inadequate for such a revision. Of the ten species of *Leirus* recognized by Regan, three are not represented in the British Museum, and five are represented only by two or three immature specimens. The form of the dorsal fin would appear to provide a useful character for the definition of genera within the family, but here the fragility of these fishes provides another difficulty in the way of a satisfactory revision, as many of the specimens in museums have the spinous part somewhat damaged, so that it is impossible to make out the exact form of the fin. Taking the key to the genus *Leirus* which appears in Regan's paper, it seems that the first division with the dorsal spines graduating to the higher soft rays forms a natural group—*Schedophilus*. This has been further subdivided by many authors into three genera: *Schedophilus*, Cocco (type *S. medusophagus*, Cocco); *Leirus*, Lowe (type *L. bennettii*, Lowe, a synonym of *Centrolophus ovalis*, Cuvier and Valenciennes);[1] and *Hoplocoryphis*, Gill (type *Schedophilus maculatus*, Günther). The second group, in which the dorsal spines are short and do not graduate to the higher soft rays, would then stand as *Palinurichthys*, Bleeker (type *Coryphaena perciformis*, Mitchill). This has been divided into three genera: *Ocycrius*, Jordan and Hubbs (type *Centrolophus japonicus*, Döderlein); *Palinurichthys*, Bleeker; and *Hyperoglyphe*, Günther (type *Diagramma porosa*, Richardson). The differences between these, however, seem to be slight, and may only be of specific importance. The genus *Centrolophus*, Lacepède, from which *Ectenias*, Jordan and Thompson, is doubtfully distinct, is closely related to *Leirus*, but may be distinguished by the elongated body and the maxillary slipping under the praeorbital for the entire length of its upper edge. The spines of the dorsal and anal fins are slender, indistinct and graduating. The genera *Nomeus*, *Cubiceps*, *Psenes*, *Seriolella*, *Psenopsis*, etc. have been well defined by Regan in the paper quoted above.

## STROMATEIDAE

**Stromateus maculatus**, Cuvier and Valenciennes. "Pampanito"; "Cagavino".

1833, *Hist. Nat. Poiss.*, IX, p. 399; Jenyns, 1842, *Zool. 'Beagle'*, Fish., p. 74; Guichenot, 1848–9, in Gay, *Hist. Chile*, Zool. II, p. 248, pl. iii, fig. 1; Günther, 1860, *Cat. Fish.*, II, p. 398; Perugia, 1891, *Ann. Mus. Civ. stor. nat. Genova* (2) X [XXX], p. 615; Berg, 1895, *Anal. Mus. Nac. B. Aires*, IV, p. 42; Steindachner, 1898, *Zool. Jahrb.*, Suppl. IV, p. 299; Delfin, 1901, *Cat. Peces Chile*, p. 57; Regan, 1902, *Ann. Mag. Nat. Hist.* (7) X, p. 204; Steindachner, 1903, *Zool. Jahrb.*, Suppl. VI, p. 206; Lönnberg, 1907, *Hamb. Magalh. Sammelr.*, Fische, p. 8; Evermann and Radcliffe, 1917, *Bull. U.S. Nat. Mus.*, XCV, p. 64; Devincenzi, 1924, *Anal. Mus. Montevideo* (II) I (5), p. 219.

St. WS 78. 13. iii. 27. 51° 01′ S, 68° 04′ 30″ W. Commercial otter trawl, 95–91 m.: 7 specimens, 290–375 mm.

St. WS 90. 7. iv. 27. 13 miles N 83° E of Cape Virgins Light, Argentine Republic. Commercial otter trawl, 82–81 m.: 4 specimens, 325–365 mm.

St. WS 217. 1. vi. 28. 46° 28′ S, 60° 18′ W. Commercial otter trawl, 146–146 m.: 1 specimen, 370 mm.

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[1] *Leirus*, Lowe (1834) is preoccupied by *Leirus*, Megerle (1823), a genus of Coleoptera, and should perhaps be replaced by *Mupus*, Cocco.

St. WS 763. 16. x. 31. 44° 14′ S, 63° 28′ W. Commercial otter trawl, 87–82 m.: 4 specimens, 200–350 mm.

St. WS 788. 13. xii. 31. 45° 05′ S, 65° 00′ W. Commercial otter trawl, 82–88 m.: 1 specimen, 195 mm.

St. WS 847. 9. ii. 32. 50° 15′ 45″ S, 67° 57′ W. Commercial otter trawl, 51–56 m.: 5 specimens, 140–175 mm.

Depth of body $2\frac{1}{5}$ to 3 in the length, length of head 4 to $5\frac{1}{3}$. Snout longer than eye, diameter of which is 4 to $6\frac{1}{4}$ in length of head; interorbital width $2\frac{1}{3}$ to 3. Maxillary not reaching eye. 12 to 14 gill-rakers on lower part of anterior arch. Dorsal III–VII 40–47; anal III (–V) 37–44. Pectoral a little shorter than, as long as, or a little longer than head, its length $3\frac{3}{5}$ to $5\frac{1}{5}$ in that of fish (without caudal). Lobes of caudal about as long as head. Bluish above, silvery below; numerous round dark spots on the upper half of the body; distal parts of fins more or less blackish.

*Hab.* Both coasts of South America, from Uruguay to Chile and Peru; Falkland Islands; Juan Fernandez.

In addition to the above, there are 12 specimens in the British Museum collection from near the Falklands, 1 from Tierra del Fuego, 2 from off the coast of Uruguay (Marini), and 5 from Bahia de Coronel, Chile (Cavendish Bentinck).

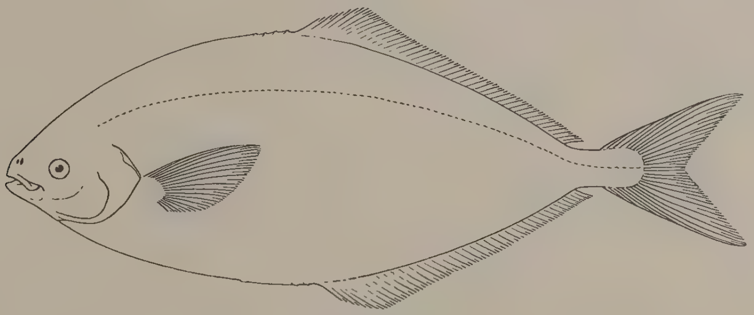

Fig. 65. *Stromateus maculatus.* × $\frac{1}{3}$.

This species presents some variation in the depth of the body, length of the head, length of the pectoral fin, and in the number of spines in the dorsal fin, and it is possible that the examination of a large series of specimens would reveal the presence of two or more races or subspecies in South America. In 4 specimens (245–270 mm.) from Chile the head seems to be a little larger (4 to $4\frac{1}{4}$ in length of fish) and the pectoral fin rather longer ($3\frac{3}{5}$ to 4 in length of fish) than in the specimens from the Patagonian-Falklands region. There appears to be some doubt as to whether the species extends as far north as Peru on the Pacific coast, but Valenciennes states that it is common in the markets at Lima during May, June and July.

## ATHERINIDAE

### Genus Austromenidia, Hubbs[1]

1918, *Proc. Acad. N.S. Philad.*, LXIX (1917), p. 307; Jordan and Hubbs, 1919, *Studies in Ichthyol., Stanford Univ. Publ. Biol. Sci.*, p. 64. Type *Basilichthys regillus*, Abbott.

This is the genus generally known to South American authors as *Basilichthys*, and includes most of the large, fine-scaled Atherines of the south-temperate region of South America. The genotype of *Basilichthys*, Girard (1854, *Proc. Acad. N.S. Philad.*, VII, p. 198), is *Atherina microlepidota*, Jenyns, a species in which the praemaxillaries are not truly protractile, the skin being interrupted over the middle of the snout.[2]

Austromenidia smitti (Lahille).

*Atherinichthys laticlavia* (part), Günther, 1861, *Cat. Fish.*, III, p. 402.
*Atherinichthys laticlavia* (*non* Cuvier and Valenciennes), Cunningham, 1871, *Trans. Linn. Soc. London*, XXVII, p. 471.
*Atherinichthys microlepidotus* (*non* Jenyns), Berg, 1895, *Anal. Mus. Nac. B. Aires*, IV, p. 28.
*Atherinichthys regia* (*non* Humboldt), Smitt, 1898, *Bih. Sv. Vet.-Akad. Handl.*, XXIV, IV, No. 5, p. 31, pl. iv, figs. 30, 31.
*Basilichthys laticlavia* (*non* Cuvier and Valenciennes), Regan, 1913, *Trans. R. Soc. Edinb.*, XLIX, p. 237.
*Basilichthys smitti*, Lahille, 1929, *Revist. Chil.*, XXXIII, p. 84; Lahille, 1929, *Bol. Minist. Agric. Nac. Republ. Argentina*, XXVIII, p. 345, figs.; Lahille, 1929–31, *Anal. Mus. Nac. B. Aires*, XXXVI, p. 105, fig.
*Basilichthys smitti* var. *australis*, Lahille, 1929, *Revist. Chil.*, XXXIII, p. 89; Lahille, 1929, *Bol. Minist. Agric. Nac. Republ. Argentina*, XXVIII, p. 345, fig.
? *Basilichthys madrynensis*, Lahille, 1929, *t.c.*, p. 344, fig.

15. iii. 32. Port Madryn. Hand line, 2 m.: 3 specimens, 180–205 mm.

Depth of body 5 to 8 (young) in the length, length of head about 5. Snout from as long to $1\frac{3}{4}$ times as long as eye, diameter of which is $3\frac{1}{2}$ (young) to $5\frac{1}{2}$ in length of head and $1\frac{1}{4}$ to nearly twice in interorbital width. Jaws about equal anteriorly; maxillary not reaching vertical from anterior margin of eye; teeth in jaws rather small; vomerine teeth present. 20 to 30 gill-rakers on lower part of anterior arch. 92 to 104 scales in a longitudinal series. Dorsal VI–VII, I 10–12; origin of spinous dorsal well behind root of pelvic, about equidistant from base of caudal and end of snout or a little nearer to the latter. Anal I 17–20; last ray nearly directly opposite that of soft dorsal. Length of pectoral about $\frac{2}{3}$ that of head. Caudal forked; caudal peduncle $3\frac{1}{2}$ to 4 times as long as deep.

*Hab.* Coast of Patagonia; Falkland Islands; Straits of Magellan; southern Chile.

Mr Bennett has sent 11 specimens (145–270 mm.) of this species, taken at Port Stanley, Falklands, in the months of January, February and March, and there are

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[1] *Odontesthes*, Evermann and Kendall, is a closely related genus, but has the head more pike-like and pointed, and the spinous dorsal is situated above the anterior part of the anal.

[2] See Eigenmann (1928, *Mem. Nat. Acad. Sci. Washington*, XXII, No. 2, p. 53) for a full discussion of the status of *Basilichthys*.

11 other specimens (68–300 mm.) in the British Museum collection from the Falklands and the Straits of Magellan.

The specimens obtained by the 'William Scoresby' mentioned above agree very well with the form described by Lahille as *Basilichthys madrynensis*, but it seems doubtful whether this is more than a local race of *Austromenidia smitti*.

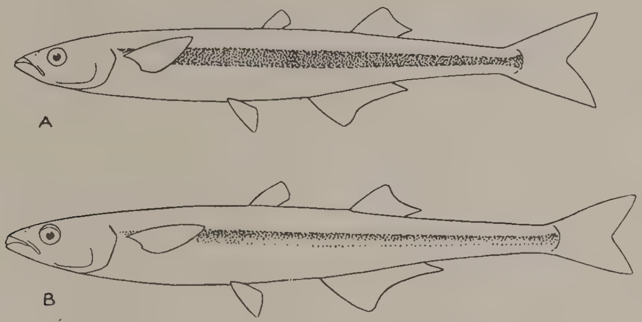

Fig. 66. A, *Austromenidia smitti*; B, *Austromenidia nigricans*. × $\frac{1}{2}$.

*A. smitti* is closely related to *A. laticlavia* (Cuvier and Valenciennes), from Chile, but may be readily distinguished by the smaller scales. Lahille recognizes two forms of this species: the typical *smitti* from Golfo Nuevo and Golfo San Matias, and *australis* from the southernmost parts of the Atlantic and Pacific coasts of South America.

**Austromenidia nigricans** (Richardson).

*Atherina nigricans*, Richardson, 1848, *Zool. 'Erebus' and 'Terror'*, Fishes, p. 77, pl. xlii, figs. 13–18.
*Atherinichthys nigricans*, Günther, 1861, *Cat. Fish.*, III, p. 403; Smitt, 1898, *Bih. Sv. Vet.-Akad. Handl.*, XXIV, IV, No. 5, p. 29, pl. iv, fig. 29.
*Atherinichthys alburnus*, Günther, 1861, *Cat. Fish.*, III, p. 404; Cunningham, 1871, *Trans. Linn. Soc. London*, XXVII, p. 471.
*Menidia patagoniensis*, Eigenmann, 1909, *Rep. Princeton Univ. Exped. Patagonia*, III, p. 280.
*Menidia alburnus*, Thompson, 1916, *Proc. U.S. Nat. Mus.*, L, p. 423.
*Austromenidia nigricans*, Jordan and Hubbs, 1919, *Studies in Ichthyol., Stanford Univ. Publ. Biol. Sci.*, p. 67.
*Basilichthys nigricans*, Lahille, 1929, *Bol. Minist. Agric. Nac. Republ. Argentina*, XXVIII, p. 345, fig.
*Basilichthys nigricans* var. *macropterus*, Lahille, 1929, *t.c.*, p. 346, fig.

Depth of body $5\frac{3}{4}$ to 7 (young) in the length, length of head $4\frac{1}{2}$ to 5. Snout from as long to $1\frac{3}{4}$ times as long as eye, diameter of which is $3\frac{1}{2}$ (young) to $4\frac{3}{4}$ in length of head and $1\frac{1}{4}$ to $1\frac{3}{4}$ in interorbital width. Jaws about equal anteriorly; maxillary extending to or nearly to vertical from anterior margin of eye; teeth in jaws rather small; vomerine teeth generally present. 12 to 16 gill-rakers on lower part of anterior arch. 90 to 105 scales in a longitudinal series. Dorsal VI–VII, I 10–12; origin of spinous dorsal a little behind root of pelvic and nearer to end of snout than to base of caudal. Anal I 17–20; last ray a little behind that of soft dorsal. Length of pectoral about $\frac{3}{4}$ that of head. Caudal more or less emarginate; caudal peduncle about 4 times as long as deep.

*Hab.* Patagonian-Falklands region; Straits of Magellan; southern Chile.

No specimens of this species were obtained by the Discovery Expedition, but Mr Bennett has sent 40 specimens (55–185 mm.) from Stanley, Falklands, as well as 8 others (55–75 mm.) from the West Falklands, collected by Mr Hamilton in March, 1932. There are also 8 specimens in the British Museum collection: the type of the species (135 mm.) from the Falklands; the 4 types of *Atherinichthys alburnus* (120–185 mm.) from the Straits of Magellan; 2 specimens (170, 175 mm.) from Sandy Point (Cunningham); and 1 specimen (170 mm.) from Magellan ('Albatross').

The two species described above, both of which are known in the Falkland Islands as "smelt", have been well distinguished by Smitt and Lahille, and Mr Bennett notes that one has a brownish back, the other a bluish. Unfortunately, the specimens sent by him have faded in spirit and it is now impossible to say which of the species has the brown back and which the blue. Mr Bennett points out that the "smelt" is erratic in its movements, and appears in shoals. "The large fish appear to spawn about September or October", he writes, "and in one instance known to me the spot selected was a shallow mud bank in a well-protected and moderately quiet inlet." It is regarded as the best table fish in the Falklands, and occasionally grows to a length of 22 in.

## SCORPAENIDAE

**Sebastodes oculatus** (Cuvier and Valenciennes). "Cabrilla."

*Sebastes oculata*, Cuvier and Valenciennes, 1833, *Hist. Nat. Poiss.*, IX, p. 466; Guichenot, 1848–9, in Gay, *Hist. Chile*, Zool. II, p. 178, pl. iii, fig. 2; Cunningham, 1871, *Trans. Linn. Soc. London*, XXVII, p. 468; Günther, 1880, *Shore Fish. 'Challenger'*, p. 20.
*Sebastes ocellatus*, Valenciennes, 1850, in Cuvier, *R. Anim.*, Disciples Ed., Poiss., pl. xxiii, fig. 3.
*Sebastes capensis* (part), Steindachner, 1881, *SitzBer. Akad. Wiss. Wien*, LXXXIII (1), p. 216.
*Sebastodes oculatus*, Jordan and Evermann, 1898, *Bull. U.S. Nat. Mus.*, XLVII (2), p. 1832; Delfin, 1901, *Cat. Peces Chile*, p. 78; Steindachner, 1903, *Zool. Jahrb.*, Suppl. VI, p. 205.
? *Sebastodes darwini*, Lönnberg, 1907, *Hamb. Magalh. Sammelr.*, Fische, p. 8.

5. v. 31. Fortune Bay, Baverstock Island. Hand line, 22 m.: 2 specimens, 255, 285 mm.

St. WS 800. 21–22. xii. 31. 48° 15′ 45″ S, 62° 09′ 52″ W. Commercial otter trawl, 137–139 m.: 1 specimen, 295 mm.

St. WS 813. 13. i. 32. 51° 35′ 15″ S, 67° 16′ 15″ W. Commercial otter trawl, 106–102 m.: 1 specimen, 400 mm.

Depth of body about 3 in the length, length of head 2$\frac{1}{3}$ to 2$\frac{2}{3}$. Snout as long as or a little longer than eye, diameter of which is 4 to 4$\frac{3}{4}$ in length of head; interorbital width $\frac{3}{5}$ to $\frac{3}{4}$ diameter of eye. Maxillary extending to below posterior part of eye. 19 to 21 gill-rakers on lower part of anterior arch. Dorsal XIII 13 or 14; fifth or sixth spines longest, their length 2$\frac{3}{5}$ to 3 in that of head. Anal III 6 (occasionally 7). Pectoral with 9 + 9 or 10 rays, its length 1$\frac{2}{5}$ to 1$\frac{2}{3}$ in that of head. Pelvics nearly or quite reaching vent. Brownish; the back mottled with darker, the pigment tending to be concentrated into 4 or 5 dark blotches; 4 or 5 more or less definite rounded pale (pink in life) spots on each side, 3 or 4 immediately below the dorsal fin and another on the lateral line about level with the eighth and ninth dorsal spines; membrane of dorsal fin more or less dusky.

*Hab.* Patagonian-Falklands region; Straits of Magellan; coast of Chile.

In addition to the above, there are 5 specimens (220–320 mm.) in the British Museum collection from the Straits of Magellan, Fortune Bay, Messier Channel and Tambo River.

*Sebastodes chilensis*, Steindachner, of which there are 4 specimens (225–340 mm.) in the British Museum, is doubtfully distinct from *S. oculatus*. The shape of the spinous dorsal fin appears to be a little different, however, the longest spines being 3 to 3⅓ in the length of the head. In the two larger specimens the coloration is considerably darker, but careful examination reveals the presence of traces of the characteristic pale spots, which are quite clear in the two smaller examples. I have not seen specimens of *S. darwini*, Cramer, from Chile and Peru, but this species is very closely related to the above.

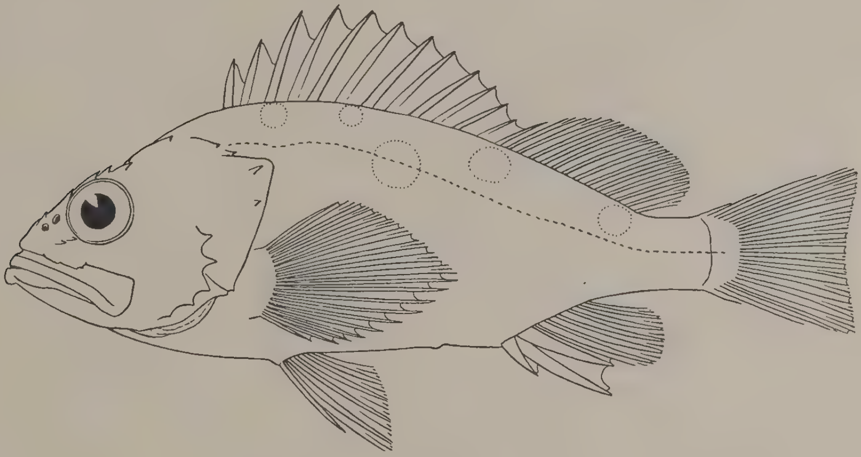

Fig. 67. *Sebastodes oculatus*. × ½.

Steindachner (1881) regarded *S. oculatus* as identical with the earlier described *S. capensis* (Gmelin), and there is no doubt that the two forms are barely separable. I have examined 8 specimens of *S. capensis* from South Africa, Tristan da Cunha, and Gough Island, and find that the only reliable difference between these and the examples from the Magellan region lies in the shape of the spinous dorsal fin. In the Cape species the third to fifth spines appear to be the longest, the length being 3¼ to nearly 4 in that of head.

In recent years American authors have tended to divide the large genus, *Sebastodes*, which contains a number of species from the coasts of California, Alaska and Japan, as well as a few from the Pacific coast of South America, into a number of genera. The differences between these, however, are slight and not always constant, and I have preferred to use the name *Sebastodes* in the wider sense of Jordan and Evermann (1898). Barnard has placed the species from South Africa, originally described as *Scorpaena capensis*, in the genus *Sebastichthys*, Gill, pointing out that this is closely allied to *Sebastodes*, differing in the short gill-rakers and narrow, concave interorbital space.

**Helicolenus lahillei, sp.n.** "Rouget."

*Helicolenus dactylopterus* (*non* Delaroche), Lahille, 1913, *Anal. Mus. Nac. B. Aires*, XXIV, p. 5, pl. ii; Devincenzi, 1924, *Anal. Mus. Montevideo* (II) I (5), p. 249; Fowler, 1927, *Proc. Acad. N.S. Philad.*, LXXVIII, p. 272.

Depth of body about 3 in the length, length of head $2\frac{3}{5}$ to $2\frac{4}{5}$. Snout shorter than eye, diameter of which is about 3 in length of head and $2\frac{2}{5}$ times the interorbital width. Praeorbital spines feeble; suborbital ridge with a small spine below the posterior edge of the eye; 5 praeopercular spines; a pair of spines on the snout between the nostrils, a spine above the front of each orbit, and 3 above its posterior angle; 2 pairs of spines on the occipital region. Maxillary with a large patch of scales, extending to below hinder part of eye. Gill-rakers of moderate length, the longest nearly $\frac{1}{2}$ diameter of eye; 19 or 20 on lower part of anterior arch. 4 or 5 series of scales between last soft-ray of dorsal and lateral line. Dorsal XII 12; third (or fourth) spine longest, about $\frac{1}{2}$ as long as head. Anal III 5. Pectoral with 19 rays, the 2 uppermost simple, the next 9 branched, and the 8 lowermost simple; fin extending to above the vent. Pelvic fin scarcely reaching the vent. Pale yellowish-brown (red in life); upper parts of sides more or less spotted or mottled with dark brown; membrane of spinous dorsal with dark spots and blotches; lining of body cavity and of branchial chamber black.

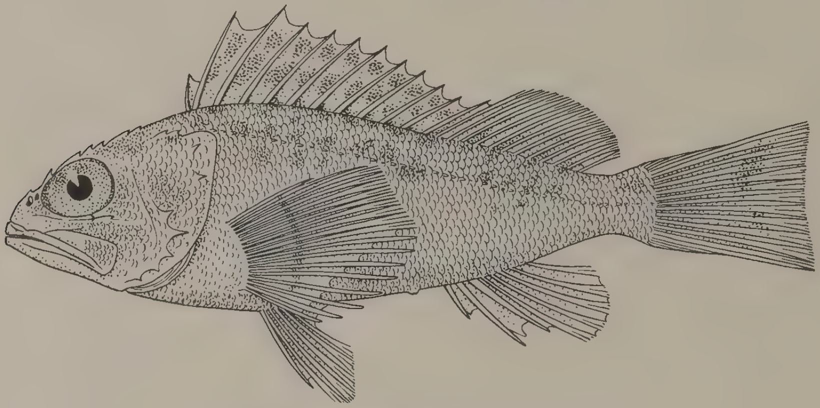

Fig. 68. *Heliocolenus lahillei*. Holotype. × $\frac{3}{4}$.

*Hab.* Coasts of Uruguay and northern Argentina.

Described from 2 specimens, 155 and 172 mm. in total length, from off the coast of Uruguay (35° S, 53° W), received from Dr Marini. The larger of these is selected as the holotype.

This fish, of which a coloured figure has been published by Lahille, has been identified by South American authors with *Helicolenus dactylopterus* (Delaroche), from the Mediterranean and adjacent parts of the Atlantic. Comparing the two small specimens described above with some of the European species of similar size, they appear to be distinguished chiefly by the more numerous gill-rakers, rather larger scales, and the higher dorsal spines. *H. lahillei* is also closely related to *H. maculatus* from South Africa, but has a smaller eye, wider interorbital region, and somewhat shorter pectoral and pelvic fins.[1] A small specimen (94 mm.) from Gough Island, obtained by the 'Scotia', is very similar to young examples of *H. maculatus*, but it is possible that this also belongs to an undescribed species.

**Helicolenus lengerichi**, sp.n.

St. WS 742. 5. ix. 31. 38° 22′ S, 73° 41′ W. Small beam trawl, 35 m.: 1 specimen, 88 mm.

Closely related to *H. maculatus* and *H. lahillei*. Depth of body $3\frac{1}{6}$ in the length, length of head $2\frac{1}{2}$. Snout a little shorter than eye, diameter of which is about $3\frac{3}{4}$ in length of head and twice the interorbital width. Interorbital region with a shallow groove. Maxillary extending nearly to below posterior edge of pupil. Longest gill-rakers about $\frac{1}{4}$ diameter of eye; 21 gill-rakers on lower part of anterior arch. 5 series of scales between last soft-ray of dorsal and lateral line. Dorsal XII 12; third (or fourth?)[2] spine longest, about $\frac{1}{3}$ as long as head. Anal III 5. Pectoral with 19 rays, the 2 uppermost simple, the next 9 branched, and the 8 lowermost simple and somewhat thickened; the fin does not nearly reach the level of the vent. Pelvic about $\frac{1}{2}$ as long as head, extending about as far as pectoral. Caudal peduncle a little longer than deep. Pale reddish-brown; upper parts of head and body spotted and marbled with darker; an irregular dark blotch at upper angle of gill-opening; dorsal irregularly marked with dusky; other fins uniformly pale; lining of body cavity and branchial chamber black.

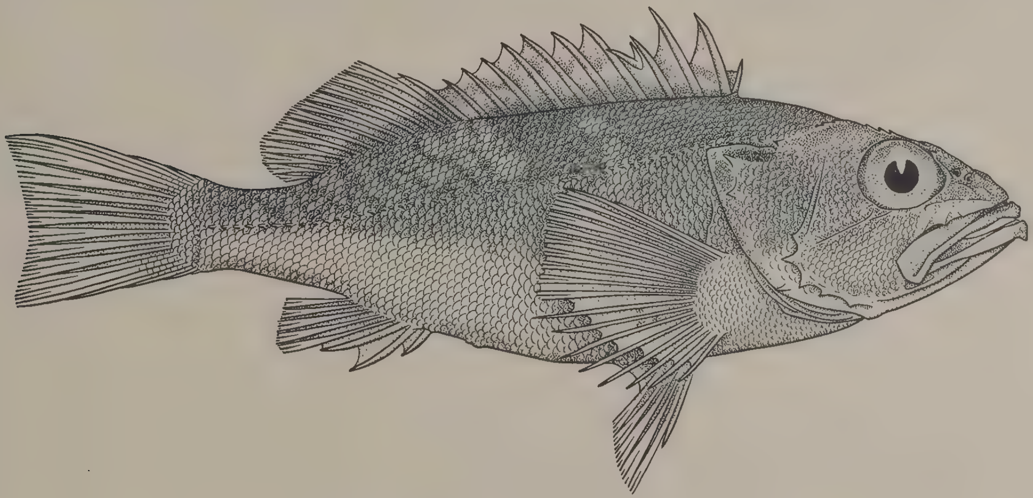

Fig. 69. *Helicolenus lengerichi*. Holotype. × $\frac{2}{5}$.

*Hab.* Chile; Juan Fernandez.

Described from a single specimen, 390 mm. in total length, the holotype of the species; collected at Juan Fernandez by Dr Lengerich and forwarded to the British

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[1] I am indebted to Dr K. H. Barnard of the South African Museum for several small specimens (125–205 mm.) of *H. maculatus* for comparison with the types of *H. lahillei*.

[2] This spine is abnormally formed in the holotype.

Museum by Mr Cavendish Bentinck. The small specimen obtained by the 'William Scoresby' probably belongs to the same species.

Distinguished from *H. maculatus* and *H. lahillei* chiefly by the somewhat larger head, the rather broader and more deeply grooved interorbital region, the more slender caudal peduncle, the smaller scales, and the shorter pectoral and pelvic fins. From *H. papillosus* (Schneider), of which *H. percoides* (Richardson) is a synonym, from Australia and New Zealand, it may be distinguished by the larger head, larger eye, more numerous gill-rakers, shorter pectoral and pelvic fins, and by the different coloration.

## CONGIOPODIDAE

**Congiopodus peruvianus** (Cuvier and Valenciennes).

"Tchirs mammachou"; "Peje chancho".

*Agriopus peruvianus*, Cuvier and Valenciennes, 1829, *Hist. Nat. Poiss.*, IV, p. 389; Guichenot, 1848–9, in Gay, *Hist. Chile*, Zool. II, p. 181, pl. ii*b*, fig. 1; Valenciennes, 1850, in Cuvier, *R. Anim.*, Disciples Ed., Poiss., pl. xxv, fig. 1; Günther, 1860, *Cat. Fish.*, II, p. 138; Günther, 1881, *Proc. Zool. Soc.*, p. 20; Berg, 1895, *Anal. Mus. Nac. B. Aires*, IV, p. 60; Steindachner, 1898, *Zool. Jahrb.*, Suppl. IV, p. 297; Delfin, 1901, *Cat. Peces Chile*, p. 80; Steindachner, 1903, *Zool. Jahrb.*, Suppl. VI, p. 205; Evermann and Radcliffe, 1917, *Bull. U.S. Nat. Mus.*, XCV, p. 139; Devincenzi, 1924, *Anal. Mus. Montevideo* (II) I (5), p. 250.

*Agriopus hispidus*, Jenyns, 1842, *Zool. 'Beagle'*, Fish., pp. 38, 163, pl. vii, fig. 2; Günther, 1860, *Cat. Fish.*, II, p. 139; Cunningham, 1871, *Trans. Linn. Soc. London*, XXVII, p. 469; Vaillant, 1888, *Miss. Sci. Cap Horn*, VI. Zool., Poiss., p. 31; Delfin, 1901, *Cat. Peces Chile*, p. 81.

*Agriopus alboguttatus*, Krøyer, 1844, *Naturhist. Tidsskrift* [2] I (3), p. 224; Günther, 1860, *Cat. Fish.*, II, p. 139; Delfin, 1901, *Cat. Peces Chile*, p. 80.

*Agriopus peruanus*, Abbott, 1899, *Proc. Acad. N.S. Philad.*, p. 361.

St. WS 217. 1. vi. 28. 46° 28′ S, 60° 18′ W. Commercial otter trawl, 146–146 m.: 2 specimens, 220, 240 mm.

St. WS 774. 1. xi. 31. 47° 08′ S, 62° 02′ W. Commercial otter trawl, 139–144 m.: 1 specimen, 160 mm.

St. WS 790. 14. xii. 31. 45° 28′ 52″ S, 63° 40′ 37″ W. Commercial otter trawl, 99–101 m.: 1 specimen, 185 mm.

St. WS 791. 14. xii. 31. 45° 38′ 45″ S, 62° 55′ W. Commercial otter trawl, 97–96 m.: 1 specimen, 200 mm.

St. WS 792. 15. xii. 31. 45° 49′ 30″ S, 62° 20′ 15″ W. Commercial otter trawl, 102–106 m.: 9 specimens, 115–210 mm.

St. WS 794(?). 17. xii. 31. 46° 12′ 37″ S, 60° 59′ 15″ W. Commercial otter trawl, 123–126 m.: 1 specimen, 285 mm.

Depth of body $2\frac{3}{4}$ to 3 in the length, length of head $3\frac{1}{5}$ to $3\frac{1}{2}$. Snout longer than eye, diameter of which is 4 (young) to 5 in length of head and about $1\frac{1}{2}$ times the narrowest part of the interorbital width. A pair of spines on the snout in front of the eyes, becoming less marked with age; granular areas in front of, above, below, and behind the eyes, and on praeopercular and temporal regions, sometimes obscured by thick skin in adults; only the upper part of the interorbital region rough. Skin covered with minute horny tubercles in the young, becoming quite smooth in examples of 100 mm. and upwards in length. A more or less distinct lateral line. Lips thick and fleshy; teeth villiform, sometimes forming a band in each jaw, sometimes arranged in 1 or 2 irregular rows; the teeth are often difficult to see owing to the fleshy nature of the gums. About 11 gill-rakers on lower part of anterior arch. Dorsal XVI–XVII 13–14; fourth to sixth spines longest, $\frac{2}{3}$ to $\frac{3}{4}$ as long as head; last spine $\frac{3}{5}$ to $\frac{3}{4}$ as long as the first soft-ray. Anal 8–10. Yellowish brown, variously spotted and marbled with black; often a more distinct pale stripe bordered with dark brown or black in the region of the lateral line; head and fins in the young often with pale dots; membrane of anterior part of spinous dorsal black, a black blotch on the upper part of the fin in the region of the sixth to ninth spines, and usually another in the region of the last four or five spines; in the young these two blotches are united and the upper part of the fin is black from the sixth spine to the last; an oblique dark blotch on soft-rays of dorsal fin; a rather broad, curved dark cross-bar on the caudal; a large black blotch on the pectoral and another on the pelvic; sometimes in adults the head, body and fins are all dark brown, the black spots and markings being nearly obscured.

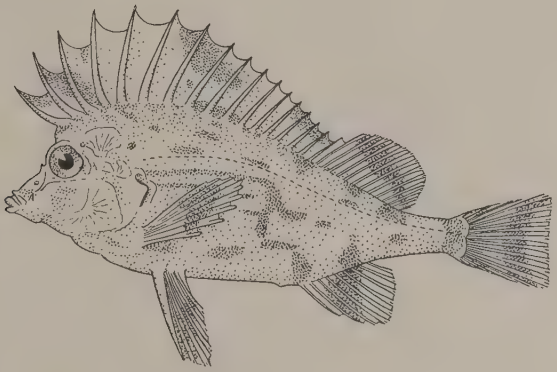

Fig. 70. *Congiopodus peruvianus.* × $\frac{1}{2}$.

*Hab.* Both coasts of southern South America, from Uruguay to Peru.

In addition to the above, there are 16 specimens (40–250 mm.) in the British Museum collection from the Straits of Magellan, west coast of Patagonia, and the coasts of Chile and Peru.

There can be little doubt that the small examples with horny tubercles (*hispidus*) represent the young of *C. peruvianus*, as was suspected by Jenyns himself. In 2 specimens examined by me, 40 and 44 mm. long, the body is thickly covered with tubercles, and these examples agree very well with Jenyns' description and figure of *hispidus*. In a specimen of 66 mm., labelled *Agriopus alboguttatus*, the tubercles are fewer and more scattered. All these specimens show faint traces of the pale dots mentioned by Krøyer in his description of *A. alboguttatus*, the type of which was about 63 mm. in total length.

Hutton (1896, *Trans. N. Zeal. Inst.*, XXVIII, p. 314) has recorded this species from New Zealand, but examination of 2 specimens (135, 142 mm.) in the British Museum, received from Hutton himself, shows that these are young examples of *C. leucopoecilus* (Richardson), a species readily distinguished from *C. peruvianus* by the more slender body, more oblique profile of the snout, more rugose head, higher dorsal spines, and by the coloration.

McCulloch (1926, *Rec. Austral. Mus.*, xv, p. 37) has discussed the status of the genus *Congiopodus*, Perry, and has given good reasons for using this name instead of *Agriopus*.

## PSYCHROLUTIDAE

**Neophrynichthys marmoratus**, Gill.

*Neophrynichthys latus* (*non* Hutton), Günther, 1881, *Proc. Zool. Soc.*, p. 20, pl. i; Lönnberg, 1907, *Hamb. Magalh. Sammelr.*, Fische, p. 11.

*Neophrynichthys marmoratus*, Gill, 1889, *Proc. U.S. Nat. Mus.*, xi (1888), p. 327.

*Besnardia gyrinops*, Lahille, 1913, *Anal. Mus. Nac. B. Aires*, xxiv, p. 3, pl. i, text-fig. 1.

*Neophrynichthys marmoratus*, Regan, 1913, *Trans. R. Soc. Edinb.*, xlix, p. 241.

St. WS 93. 9. iv. 27. 7 miles S 80° W of Beaver Island, West Falkland Islands. Commercial otter trawl, 133–130 m.: 1 specimen, 110 mm.

St. WS 97. 18. iv. 27. 49° 00′ 30″ S, 61° 58′ W. Commercial otter trawl, 146–145 m.: 1 specimen, 165 mm.

St. WS 583. 2. v. 31. 53° 39′ S, 70° 54′ 30″ W. Small beam trawl, 14–78 m.: 1 specimen, 100 mm.

As Regan has pointed out, this species may be distinguished by the greater development of the dermal appendages on the head and anterior part of the body, which are much longer and set further apart than in *N. latus* from New Zealand. In addition, the interorbital region is much narrower, the caudal fin more rounded, and the coloration different. The dorsal rays number IX–X 15–16, the anal rays 11 or 12.

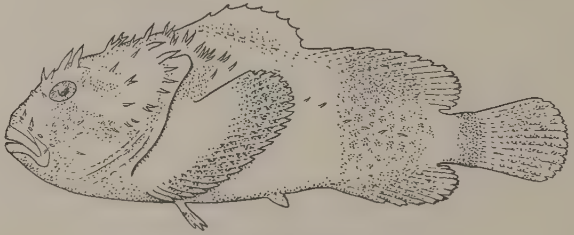

Fig. 71. *Neophrynichthys marmoratus*. × ½.

*Hab.* Coasts of south-eastern South America, from the Rio Plata to the Straits of Magellan.

There are 2 large specimens (320, 390 mm.) in the British Museum from the Straits of Magellan—the types of Regan's *N. marmoratus*—and the 'Scotia' obtained a smaller example (160 mm.) from the Burdwood Bank in 56 fathoms. The type of *Besnardia gyrinops* is 337 mm. in total length: this fish is said to be known locally as "Gran sapo de Mar".

The form of the pelvic fins in this species is of some interest. These appear to arise from a pocket-like fold of the skin, and in preserved specimens the fins may be completely everted, presenting a normal appearance, or may be withdrawn so that only the tips project through the opening of the pocket. An exactly similar state of affairs is found in the Pediculate fish *Chaunax pictus*.

## AGONIDAE

**Agonopsis chiloensis (Jenyns).** "Aayakich."

*Aspidophorus chiloensis*, Jenyns, 1842, *Zool. 'Beagle'*, Fish., p. 30, pl. vii, fig. 1; Guichenot, 1848–9, in Gay, *Hist. Chile*, Zool. II, p. 174.

*Aspidophorus niger*, Krøyer, 1844, *Naturhist. Tidsskrift* [2] I (3), p. 238.

*Agonus niger*, Günther, 1860, *Cat. Fish.*, II, p. 215.

*Agonus chiloensis*, Günther, 1860, *t.c.*, p. 216; Günther, 1880, *Shore Fish. 'Challenger'*, p. 21; Vaillant, 1888, *Miss. Sci. Cap Horn*, VI, Zool., Poiss., p. 31; Lahille, 1913, *Revist. Chil.*, XVII, p. 179, pl. xv.

*Agonopsis chiloensis*, Gill, 1862, *Proc. Acad. N.S. Philad.* (1861), p. 167; Jordan and Evermann, 1898, *Bull. U.S. Nat. Mus.*, XLVII (2), p. 2069; Delfin, 1901, *Cat. Peces Chile*, p. 81.

*Agonopsis asperoculis*, Thompson, 1916, *Proc. U.S. Nat. Mus.*, L, p. 409, pl. ii, fig. 1.

St. WS 71. 23. ii. 27. 6 miles N 60° E of Cape Pembroke Light, East Falkland Islands. Commercial otter trawl, 82 m.: 20 specimens, 95–120 mm.

St. WS 81. 19. iii. 27. 8 miles N 11° W of North Island, West Falkland Islands. Commercial otter trawl, 81–82 m.: 2 specimens, 60, 115 mm.

St. WS 83. 24. iii. 27. 14 miles S 64° W of George Island, East Falkland Islands. Commercial otter trawl, 137–139 m.: 4 specimens, 105–125 mm.

St. WS 93. 9. iv. 27. 7 miles S 80° W of Beaver Island, West Falkland Islands. Commercial otter trawl, 133–130 m.: 1 specimen, 115 mm.

St. WS 95. 17. iv. 27. 48° 58′ 15″ S, 64° 45′ W. Commercial otter trawl, 109–108 m.: 4 specimens, 140–150 mm.

St. WS 216. 1. vi. 28. 47° 37′ S, 60° 50′ W. Net (7 mm. mesh) attached to back of trawl, 219–133 m.: 1 specimen, 35 mm.

St. WS 219. 3. vi. 28. 47° 06′ S, 62° 12′ W. Net (7 mm. mesh) attached to back of trawl, 116–114 m.: 3 specimens, 33–50 mm.

St. WS 221. 4. vi. 28. 48° 23′ S, 65° 10′ W. Tow-net attached to back of trawl, 76–91 m.: 1 specimen, 40 mm.

St. WS 243. 17. vii. 28. 51° 06′ S, 64° 30′ W. Net (7 mm. mesh) attached to back of trawl, 144–141 m.: 1 specimen, 140 mm.

St. WS 583. 2. v. 31. 53° 39′ S, 70° 54′ 30″ W. Small beam trawl, 14–78 m.: 5 specimens, 108–130 mm.

St. WS 749. 18. ix. 31. 52° 39′ 30″ S, 69° 53′ 30″ W. Rectangular net, 40 m.: 1 specimen, 82 mm.

St. WS 754. 20 ix. 31. 51° 09′ 30″ S, 58° 54′ W. Rectangular net, 111 m.: 3 specimens, 60–66 mm.

St. WS 767. 19. x. 31. 45° 12′ S, 61° 41′ W. Rectangular net, 98 m.: 1 specimen, 135 mm.

St. WS 787. 7. xii. 31. 48° 44′ S, 65° 24′ 30″ W. Net (7 mm. mesh) attached to back of trawl, 106–110 m.: 3 specimens, 115–143 mm.

St. WS 836. 3. ii. 32. 53° 05′ 30″ S, 67° 38′ W. Small beam trawl, 64 m.: 1 specimen, 80 mm.

*Hab.* Argentina; Patagonian-Falklands region; Straits of Magellan; Chile.

In addition to the above, there are 9 specimens (37–190 mm.) in the British Museum collection, including the types of the species (62 and 63 mm.) from the Chiloe Islands.

*A. asperoculis*, Thompson, based upon a single specimen (60 mm.) from just south of the Rio Plata, is said to differ from *A. chiloensis* in "the much more slender tail; the wider spacing of the dorsals, which are five instead of two scales apart; the presence of a series of small spines on the upper surface of the eyeball; the slightly larger eye; the very much smaller barbels on the lower jaw; and the position of the vent nearly opposite mid-length of the ventrals". After examining a series of some 55 specimens, I find that nearly all these characters are subject to considerable variation. The caudal peduncle is from 4 to 7 times as long as deep; the two dorsal fins are separated by from 2 to 5 scales; the series of small spines on the eyeball is present in all the specimens, including the types of *A. chiloensis*; the diameter of the eye is 3 to 4¼ in the length of the head; the interorbital width is ⅔ to ⅞ of the diameter of the eye; the number and size of the barbels varies exceedingly; and the vent is sometimes opposite to the middle, sometimes opposite to the posterior parts of the pelvic fins. The form and extent of the spines on the head and body is also subject to some variation. There are nearly always 5 or 6 distinct dark cross-bars on the back, with other less definite dark markings on the sides and on the nape; the pectoral fin has a broad dark cross-bar distally and another across its base; the caudal has 2 similar bars and a narrow pale posterior margin; the dorsal fins are plain or irregularly marked with darker; the anal is similar, or sometimes with some vivid white patches; the barbels are all pure white.

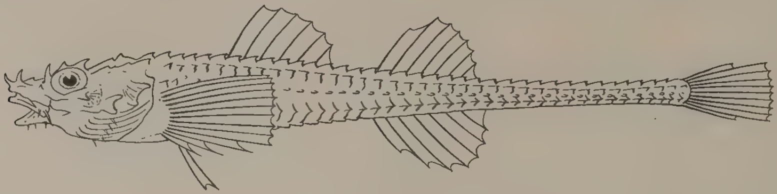

Fig. 72. *Agonopsis chiloensis.* × ¾.

## LIPARIDAE

**Careproctus falklandica** (Lönnberg).

*Liparis antarctica falklandica*, Lönnberg, 1905, *Wiss. Ergebn. Schwed. Südpol.-Exped.*, v (6), p. 17, pl. iii, fig. 12.

*Careproctus falklandica*, Burke, 1912, *Ann. Mag. Nat. Hist.* (8) IX, p. 513; Burke, 1930, *Bull. U.S. Nat. Mus.*, CL, p. 116.

St. WS 89. 7. iv. 27. 9 miles N 21° E of Arenas Point Light, Tierra del Fuego. Commercial otter trawl, 23–21 m.: 6 specimens, 30–53 mm.

*Hab.* Falkland Islands; Burdwood Bank; Straits of Magellan.

This species is closely related to *C. pallidus* (Vaillant) from Orange Bay, but the latter is said to have only 20 rays in the pectoral fin, which is apparently not notched. The type of *C. pallidus* is 42 mm. in total length.

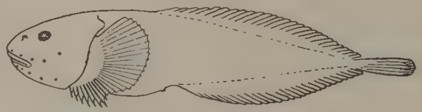

Fig. 73. *Careproctus falklandica.* × 1½.

According to a note on the label, the specimens collected by the 'William Scoresby' were pale orange in colour during life.

**Paraliparis, sp.**

The following specimens are in very poor condition and cannot be specifically identified:

St. WS 748. 16. ix. 31. 53° 41′ 30″ S, 70° 55′ W. Rectangular net, 300 m.: 1 specimen, 42 mm.

St. WS 749. 18. ix. 31. 52° 39′ 30″ S, 69° 53′ 30″ W. Rectangular net, 40 m.: 1 specimen, about 44 mm.

## BOTHIDAE[1]

**Thysanopsetta naresi**, Günther.

1880, *Shore Fish. 'Challenger'*, p. 22, pl. xi, fig. A; Delfin, 1901, *Cat. Peces Chile*, p. 104; Dollo, 1904, *Rés. Voy. 'Belgica'*, Poiss., p. 91; Lönnberg, 1907, *Hamb. Magalh. Sammelr.*, Fische, p. 14; Norman, 1930, *Discovery Reports*, II, p. 358; Norman, 1934, *Syst. Monogr. Flatfishes*, I, p. 64, fig. 33.

St. 51, St. WS 77, St. WS 90–92, St. WS 96–97, St. WS 216, St. WS 219, St. WS 222. Patagonian-Falklands-Magellan region: 58 specimens, 34–142 mm.

The following additional specimens have come to light since the publication of my previous report:

St. WS 80. 14. iii. 27. 50° 57′ S, 63° 37′ 30″ W. Commercial otter trawl, 152–151 m.: 1 specimen, 62 mm.

St. WS 94. 16. iv. 27. 50° 00′ 15″ S, 64° 57′ 45″ W. Commercial otter trawl, 110–126 m.: 1 specimen, 60 mm.

St. WS 96. 17. iv. 27. 48° 00′ 45″ S, 64° 58′ W. Commercial otter trawl, 96 m.: 7 specimens, 35–38 mm. [Taken from stomach of *Merluccius hubbsi.*]

St. WS 742. 5. xi. 31. 38° 22′ S, 73° 41′ W. Small beam trawl, 35 m.: 1 specimen, 109 mm.

St. WS 787. 7. xii. 31. 48° 44′ S, 65° 24′ 30″ W. Net (7 mm. mesh) attached to back of trawl, 106–110 m.: 29 specimens, 58–115 mm.

St. WS 791. 14. xii. 31. 45° 41′ 45″ S, 62° 45′ W. Commercial otter trawl, 96–101 m.: 2 specimens, 115–132 mm.

St. WS 795. 18. xii. 31. 46° 14′ S, 60° 24′ W. Net (7 mm. mesh) attached to back of trawl, 157–161 m.: 12 specimens, 55–135 mm.

St. WS 796. 19. xii. 31. 47° 49′ 37″ S, 63° 42′ 30″ W. Nets attached to back of trawl, 106–113 m.: 12 specimens, 120–130 mm.

St. WS 797. 20. xii. 31. 47° 45′ 18″ S, 64° 10′ 30″ W. Nets attached to back of trawl, 115–112 m.: 13 specimens, 35–42 mm.

St. WS 808. 8. i. 32. 49° 40′ 15″ S, 65° 42′ W. Seine net attached to back of trawl, 109–107 m.: 40 specimens, 60–102 mm.

St. WS 809. 8. i. 32. 49° 28′ 15″ S, 66° 29′ W. Seine net attached to back of trawl, 107–104 m.: 1 specimen, 88 mm.

*Hab.* Patagonian-Falklands region; Straits of Magellan; southern Chile northwards to Mocha Island.

In addition to the above, there are 3 specimens in the British Museum collection from off Cape Virgins, Argentina, including the type of the species (175 mm.). The specimens collected by the Discovery Expedition fit very well into the description given in my monograph, except that the range in the number of dorsal and anal rays is greater. The number of dorsal rays varies from 78 to 90, the number of anal rays from 57 to 66. The single specimen taken at Mocha Island extends the known range of the species considerably further north on the Chilean coast. This specimen is much darker than most of the others, the coloration being blackish with numerous small, scattered, pale spots. In the young of this species the head and body are covered with a large number of small dark brown spots.

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[1] Some of the Heterosomata have been dealt with in a previous report. For the sake of completeness, the species from this region are listed again here.

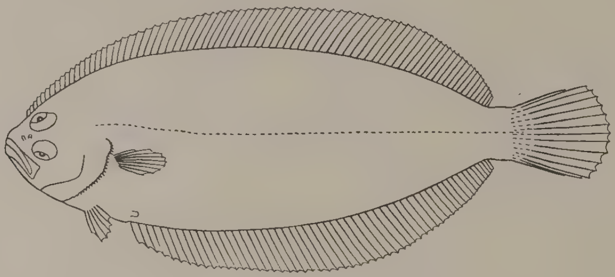

Fig. 74. *Thysanopsetta naresi.* × $\frac{3}{4}$.

**Hippoglossina macrops,** Steindachner.

1876, *SitzBer. Akad. Wiss. Wien*, LXXIV (1), p. 13, pl. iii; Abbott, 1899, *Proc. Acad. N.S. Philad.*, p. 475.

? *Hippoglossina macrops* (part), Lönnberg, 1907, *Hamb. Magalh. Sammelr.*, Fische, p. 14.

St. WS 742. 5. ix. 31. 38° 22′ S, 73° 41′ W. Small beam trawl, 35 m.: 1 specimen, 123 mm.

Depth of body $2\frac{2}{5}$ in the length, length of head about 3. Snout shorter than eye, diameter of which is about 4 in length of head. Maxillary extending to below middle of eye. 12 gill-rakers on lower part of anterior arch. About 78 scales in the lateral line; scales on blind side ctenoid only on the posterior part of the body. Dorsal (66–67) 69; anal (52) 56. Pectoral of ocular side with 12 rays, length about $\frac{1}{2}$ that of head. Caudal rounded; caudal peduncle a little deeper than long.

*Hab.* Coast of Chile.

**Hippoglossina mystacium,** Ginsburg.

*Hippoglossina macrops* (*non* Steindachner), Günther, 1881, *Proc. Zool. Soc.*, p. 21; Thompson, 1916, *Proc. U.S. Nat. Mus.*, L, p. 424; Norman, 1934, *Syst. Monogr. Flatfishes*, I, p. 67, fig. 35.

? *Hippoglossina macrops* (part), Lönnberg, 1907, *Hamb. Magalh. Sammelr.*, Fische, p. 14.

*Hippoglossina mystacium*, Ginsburg, 1936, *J. Wash. Acad. Sci.*, XXVI, p. 130, fig. 1.

*Hab.* Straits of Magellan; southern Chile.

This species is very closely related to *H. macrops*, but, as Ginsburg has pointed out, it has a somewhat more slender body, a smaller head, and the ctenoid scales on the blind side of the body appear to extend further forward. The type is 183 mm. in total length (U.S.N.M. No. 77393), from near the Taitao Peninsula, southern Chile ('Albatross' St. 2787), and, although Ginsburg makes no mention of this fact, this is clearly the specimen examined by Thompson. No examples of this species were obtained by the Discovery Expedition, but re-examination of the 2 specimens (132, 205 mm.) from Trinidad Channel, Magellan Strait, previously identified by me as

*H. macrops*, suggests that these are referable to Ginsburg's species. It seems probable that *H. mystacium* occurs in the Straits of Magellan and on the southern part of the Chilean coast, whereas *H. macrops* appears to be more northerly in its distribution.

**Paralichthys microps** (Günther).

? *Hippoglossus kingii*, Jenyns, 1842, *Zool. 'Beagle'*, Fish., p. 138, pl. xxvi.

*Hippoglossina microps*, Günther, 1881, *Proc. Zool. Soc.*, p. 21; Delfin, 1901, *Cat. Peces Chile*, p. 103.

*Pseudorhombus kingii*, Reed, 1897, *Cat. Peces Chile*, p. 16.

? *Paralichthys jordani*, Steindachner, 1898, *Zool. Jahrb.*, Suppl. IV, p. 325; Delfin, 1901, *Cat. Peces Chile*, p. 104.

*Paralichthys kingii*, Delfin, 1901, *t.c.*, p. 104.

*Paralichthys microps*, Norman, 1934, *Syst. Monogr. Flatfishes*, I, p. 88, fig. 52.

St. WS 742. 5. ix. 31. 38° 22′ S, 73° 41′ W. Small beam trawl, 35 m.: 16 specimens, 50–190 mm.

Depth of body 2 to $2\frac{1}{3}$ in the length, length of head $3\frac{1}{6}$ to $3\frac{1}{2}$. Snout about as long as eye (shorter in young), diameter of which is $4\frac{1}{2}$ to $5\frac{1}{2}$ in length of head and much greater than interorbital width. 18 to 23 gill-rakers on lower part of anterior arch. Scales ctenoid on ocular side, cycloid on blind side; 85 to 97 in the lateral line. Dorsal 68–80; origin behind posterior nostril of blind side and above middle or anterior half of eye. Anal 56–65. Pectoral of ocular side with 11 or 12 rays, length about $\frac{1}{2}$ that of head. Caudal peduncle $1\frac{1}{5}$ to $1\frac{1}{2}$ times as deep as long. Brownish or blackish, mottled and spotted with darker; median fins blackish towards their margins; pectoral with small dark spots.

*Hab.* West coast of Patagonia; Chile.

In addition to the above, there are 6 specimens (107–255 mm.) in the British Museum collection, including the holotype of the species (Coppinger—'Alert'), one from the coast of Chile (Delfin), and 4 from near Concepcion (Cavendish Bentinck).

I have hesitated to adopt the name *kingii* for this species, as Jenyn's species was based upon a coloured sketch of a fish made by Captain King, an officer of the 'Beagle', and no specimen was preserved. The drawing shows the dorsal fin composed of two portions, differing in structure, rather suggestive of a *Psettodes*, and there is no evidence that it is intended to represent a species of *Paralichthys*. *P. adspersus* (Steindachner), from the coasts of Chile and Peru, is very closely related to *P. microps*, differing chiefly in the somewhat deeper body, more anterior origin of the dorsal fin, and the rather lower number of gill-rakers.

**Paralichthys patagonicus, Jordan and Goss.** "Lenguado."

*Platessa orbignyana* (*non* Valenciennes), Jenyns, 1842, *Zool. 'Beagle'*, Fish., p. 137.

? *Pseudorhombus dentatus* (*non* Linnaeus), Günther, 1862, *Cat. Fish.*, IV, p. 425.

*Paralichthys patagonicus*, Jordan and Goss, 1889, *Rep. U.S. Fish. Comm.*, XIV (1886), p. 248; Berg, 1895, *Anal. Mus. Nac. B. Aires*, IV, p. 77; Evermann and Kendall, 1906, *Proc. U.S. Nat. Mus.*, XXXI, p. 107; Devincenzi, 1924, *Anal. Mus. Montevideo* (II) I (5), p. 278; Norman, 1934, *Syst. Monogr. Flatfishes*, I, fig. 44; Ginsburg, 1936, *J. Wash. Acad. Sci.*, XXVI, p. 132.

? *Paralichthys bicyclophorus*, Ribeiro, 1915, *Arch. Mus. Nac. Rio Janeiro*, XVII, Heterosomata, p. 14, fig.; MacDonagh, 1934, *Revista Mus. La Plata*, XXXIV, p. 56.

Depth of body about $2\frac{1}{3}$ in the length, length of head $3\frac{2}{3}$ to nearly 4. Diameter of eye 5 to $5\frac{1}{2}$ in length of head, greater than interorbital width. 11 gill-rakers on lower part of anterior arch. Scales ctenoid on ocular side, cycloid on blind side; 103 to 107 in lateral line. Dorsal 76–85; anal 60–69.

*Hab.* Coasts of southern Brazil, Uruguay and Argentina, southwards to northern Patagonia.

No specimens of this species were obtained by the expedition, but the British Museum has recently received two fine examples (330, 380 mm.) from Buenos Aires, through the courtesy of Messrs A. Gardella Ltd.

In my monograph I erroneously united this species, of which I had seen no specimens, with Ranzani's *P. brasiliensis* [= *P. vorax* (Günther)], but, as Ginsburg has pointed out, it may be readily distinguished by the more numerous scales, which are ctenoid on the ocular side. The same author regards *P. bicyclophorus*, Ribeiro, as probably synonymous with *P. patagonicus*. By softening the dried skin recorded by Jenyns as *Platessa orbignyana* I have been able to count the gill-rakers, and find about 10 of these on the lower part of the anterior arch. This specimen cannot, therefore, belong to the species *P. orbignyana* as defined in my monograph, and should most probably be placed here. The large stuffed specimen from Port Famine, identified by Günther as *P. dentatus* (Linnaeus), appears to have finely ciliated scales on the ocular side of the body, and there are about 100 in the lateral line. It would, therefore, seem to be referable to this species rather than to *P. brasiliensis* (Ranzani), although in certain respects it resembles *P. hilgendorfi*, Steindachner, and *P. schmitti*, Ginsburg.

**Paralichthys isosceles**, Jordan.

1891, *Proc. U.S. Nat. Mus.*, XIII, p. 330; Norman, 1934, *Syst. Monogr. Flatfishes*, I, p. 80.
*Pseudorhombus isosceles*, Ginsburg, 1936, *J. Wash. Acad. Sci.*, XXVI, p. 131.

St. WS 762. 16. x. 31. 43° 50′ S, 65° 01′ 51″ W. Commercial otter trawl, 67–65 m.: 2 specimens, 140, 220 mm.

St. WS 763. 16. x. 31. 44° 14′ S, 63° 28′ W. Commercial otter trawl, 87–82 m.: 3 specimens, 215–305 mm.

St. WS 788. 13. xii. 31. 45° 05′ S, 65° 00′ W. Commercial otter trawl, 82–88 m.: 1 specimen, 205 mm.

St. WS 852. 21. iii. 32. 44° 12′ 30″ S, 64° 13′ W. Small beam trawl, 86–88 m.: 2 specimens, 215, 285 mm.

Depth of body 2 to $2\frac{1}{4}$ in the length, length of head $3\frac{2}{5}$ to 4. Upper profile of head generally a little notched in front of upper eye. Snout about as long as eye, diameter of which is $3\frac{3}{5}$ to $4\frac{1}{4}$ in length of head; eyes separated by a narrow ridge. Maxillary extending to below middle or posterior part of eye, length about 2 in head; lower jaw not projecting. No distinct canine teeth. 8 or 9 gill-rakers on lower part of anterior arch. Scales ctenoid on both sides of body; 73 to 79 in lateral line;[1] no supplementary scales.[1] Dorsal 79–87; origin immediately behind posterior nostril of blind side and in front of eye. Anal 58–69. Pectoral of ocular side with 11 rays, length $1\frac{1}{2}$ to $1\frac{4}{5}$ in that of head. Caudal double-truncate; caudal peduncle more than twice as deep as long. Brownish; generally more or less mottled or spotted with darker; generally an indistinct dark spot above the curve of the lateral line and sometimes another behind the pectoral fin; three large round dark ocelli forming a triangle, a pair above and below the lateral line and near edges of body, the third on lateral line just before end of dorsal; fins all more or less speckled or mottled with darker; pelvic of ocular side dusky, with one to three small black spots.

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[1] I am greatly indebted to Mr I. Ginsburg for the information that Jordan was in error in his count of the scales in the types of *P. isosceles*, and that the number should be 74 to 78. Mr Ginsburg has also been kind enough to send me a galley proof of his paper dealing with this and other related Flatfishes, for which courtesy I take this opportunity of offering my sincere thanks.

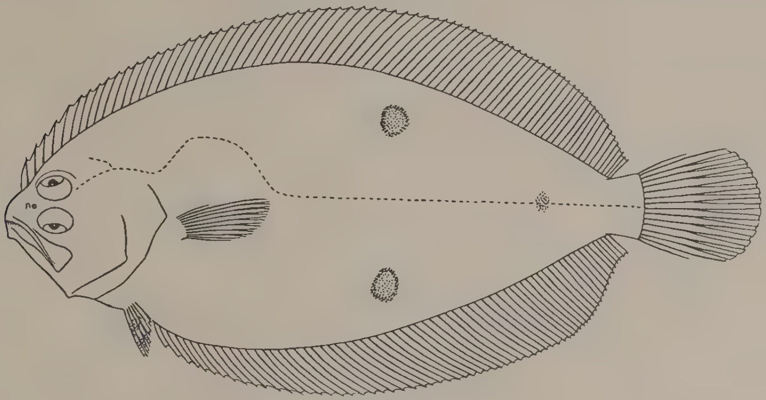

Fig. 75. *Paralichthys isosceles.* × ½.

*Hab.* Northern Patagonia.

The types of this species were 125–280 mm. in total length. It is closely related to *P. triocellatus*, Ribeiro, from which it may be distinguished by the smaller scales, which are ctenoid on both sides of the body, and by the somewhat deeper body.

**Xystreurys rasile** (Jordan). "Lenguado."

*Verecundum rasile*, Jordan, 1891, *Proc. U.S. Nat. Mus.*, XIII, p. 330.

*Hippoglossina notata*, Berg, 1895, *Anal. Mus. Nac. B. Aires*, IV, p. 75.

*Xystreurys notatus*, Ribeiro, 1904, *Lavoura* [*Bol. Soc. nac. Agricult.*], 4–7 (1903), p. 192; Ribeiro, 1915, *Arch. Mus. Nac. Rio Janeiro*, XVII, Heterosomata, p. 11.

*Xystreurys brasiliensis*, Regan, 1914, *Ann. Mag. Nat. Hist.* (8) XIII, p. 17; Regan, 1914, *Rep. Brit. Antarct.* ('*Terra Nova*') *Exped.* 1910, Zool., I, p. 23, pl. X, fig. 1.

*Xystreurys rasile*, Norman, 1934, *Syst. Monogr. Flatfishes*, I, p. 121, fig. 77.

St. WS 762. 16. x. 31. 43° 50′ S, 65° 05′ 06″ W. Commercial otter trawl, 67–65 m.: 1 specimen, 260 mm.

St. WS 771. 29. x. 31. 42° 41′ 45″ S, 60° 31′ W. Commercial otter trawl, 90 m.: 2 specimens, 233, 235 mm.

St. WS 852. 21. iii. 32. 44° 12′ 30″ S, 64° 13′ W. Small beam trawl, 86–88 m.: 1 specimen, 200 mm.

Depth of body $2\frac{1}{3}$ to $2\frac{2}{3}$ in the length, length of head 4 to $4\frac{3}{5}$. Snout rather shorter than eye, diameter of which is $2\frac{5}{6}$ (young) to 4 in length of head. Maxillary extending to below anterior part or middle of eye. 10 or 11 gill-rakers on lower part of anterior arch. 78 to 86 scales in lateral line. Dorsal 79–84; anal 64–68. Length of pectoral fin of ocular side varying from $\frac{3}{4}$ to a little more than once that of head. Brownish; a large ocellus or spot (sometimes double) at the junction of curved and straight parts of lateral line and a smaller spot between this and the dorsal fin; a black spot posteriorly on straight portion of lateral line; fins spotted with darker.

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[1] The absence of supplementary scales leads Mr Ginsburg to place this species in the genus *Pseudorhombus* (as defined by him), but I am not yet convinced of the value of this character in the definition of genera.

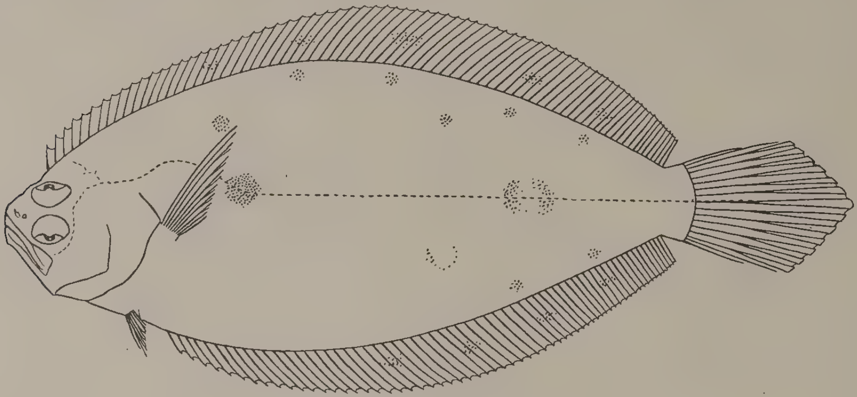

Fig. 76. *Xystreurys rasile.* × ½.

*Hab.* Coasts of southern Brazil, Uruguay and Argentina, southwards to northern Patagonia.

In addition to the above, there are 4 specimens (98–260 mm.) in the British Museum collection, the types of *Xystreurys brasiliensis* and two from off the coast of Uruguay (Marini).

**Mancopsetta maculata** (Günther).

*Lepidopsetta maculata*, Günther, 1880, *Shore Fish. 'Challenger'*, p. 18, pl. XXX, fig. C; Norman, 1930, *Discovery Reports*, II, p. 361.

*Mancopsetta maculata*, Jordan, 1920, *Genera Fish.*, IV, p. 514; Norman, 1934, *Syst. Monogr. Flatfishes*, I, p. 248, fig. 189.

St. WS 218. North of the Falkland Islands: 1 specimen, 238 mm.

*Hab.* Near Prince Edward's Island, southern Indian Ocean; north of the Falkland Islands, southern Atlantic.

The holotype in the British Museum collection is 134 mm. long.

**Achiropsetta tricholepis**, Norman.

1930, *Discovery Reports*, II, p. 362, fig. 47; Norman, 1934, *Syst. Monogr. Flatfishes*, I, p. 249, fig. 190.

St. WS 89. Off Tierra del Fuego: 1 specimen (holotype), 100 mm.

*Hab.* Patagonian-Falklands region.

Since the publication of my previous report I have received a second example of this interesting species, collected in the Falkland Islands (? 1922) by Mr Hamilton. This specimen is in very poor condition, and measures about 105 mm. in total length.

# GENERAL PART

## THE PATAGONIAN REGION

In his report on the fishes of the 'Terra Nova' Expedition, Regan (1914) has discussed the distribution of Antarctic and Sub-Antarctic coast fishes in some detail, and concludes that south of the Tropical Zone the distribution of these fishes is best illustrated by the following classification:

South Temperate Zone, with seven districts: Chile, Argentina, Tristan da Cunha, Cape, St Paul, Australia, and New Zealand.

Sub-Antarctic Zone, with two districts: Magellan and Antipodes.

Antarctic Zone, with two districts: Glacial and Kerguelen.

The Patagonian region, as here understood, includes Tierra del Fuego, the coasts of Patagonia northward as far as Chiloe on the west and as far as the San José or Valdes Peninsula (about latitude 42° S) on the east, the Falkland Islands, and the Burdwood Bank. The northern and southern limits of the region correspond very closely to the mean annual surface isotherms of 12° C. and 6° C., and apart from the fact that its northern boundary on the east coast lies about 300 miles north of Cape Blanco, the Patagonian region represents the Magellan district as delimited by Regan. By taking the boundary as far north as the San José Peninsula all the stations made by the 'William Scoresby' during her trawling surveys are included within the area.

### HISTORICAL[1]

Bougainville (1771), in his account of a voyage round the world in the 'Boudeuse' and the 'Étoile', in which he was accompanied by Commerson, appears to have been the first to mention the fishes of the Patagonian region, and has some notes on the "Muge" (*Eleginops*), "Brochet transparent" (*Galaxias*), and "Truite" (*Aplochiton*), from the Falkland Islands (Malouines).

Captain Cook's second expedition with the 'Adventure' and the 'Resolution' between 1772 and 1775, accompanied by J. R. Forster as naturalist (with his son J. G. Forster as assistant), obtained three species of fish from Tierra del Fuego. The specimens were not preserved, but the species were given names by Schneider (1801) on the basis of the MS. notes and the drawings made by J. G. Forster, and the descriptions were also published by Forster (1844). The notes and drawings are in the library of the British Museum (Natural History), but only one of the fishes (*Harpagifer bispinis*) can be identified with certainty. One of the others is a species of *Notothenia*, probably *N. macrocephala*, and the last is either a *Cottoperca* or a *Notothenia* and may well be *Cottoperca gobio*. The earliest fishes described from the Patagonian region are, thus:

*Gadus magellanicus*, Schneider (? *Notothenia macrocephala*).
*Callionymus trigloides*, Schneider (? *Cottoperca gobio*).
*C. bispinis*, Schneider (*Harpagifer bispinis*).

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[1] Much of the data for this section has been obtained from the valuable summary of Dollo (1904, pp. 67–78).

During the voyage of the 'Coquille' between 1822 and 1825 a species of fish was obtained from the Falkland Islands and described by Lesson (1830) as *Stomias variegatus*. The exact determination of this species is doubtful, but Cuvier and Valenciennes identify it with *Galaxias maculatus* (Jenyns). Lesson also mentions the so-called "Mullet" of the Falklands (*Eleginops maclovinus*).

During the surveying voyages of the 'Adventure' and 'Beagle' in the years 1826 to 1836, under the command of Captain P. P. King, certain species of fish were obtained at Port Famine and elsewhere. The specimens, which are stuffed skins, were sent to the Zoological Society of London, and were not acquired by the British Museum until 1857. A few years later Günther (1861) described two of them as new species:

*Aphritis gobio*, Günther (*Cottoperca gobio*).
*Chaenichthys esox*, Günther (*Champsocephalus esox*).

The historic voyage of the 'Beagle' (1832–1836), under the command of Captain R. Fitzroy, and with Charles Darwin as naturalist, obtained 19 species of fish from the Patagonian region, which were later described by Jenyns (1842):

*Myxine australis*, Jenyns.
*Clupea fuegensis*, Jenyns.
*Mesites maculatus*, Jenyns (*Galaxias maculatus*).
*M. alpinus*, Jenyns (*Galaxias alpinus*).
*M. attenuatus*, Jenyns (*Galaxias attenuatus*).
*Aplochiton zebra*, Jenyns.
*A. taeniatus*, Jenyns.
*Conger punctus*, Jenyns (*Ariosoma*(?) *punctus*).
*Perca laevis*, Jenyns (*Percichthys trucha*).
*Paropsis signata*, Jenyns (*Parona signata*).
*Aphritis undulatus*, Jenyns (*Eleginops maclovinus*).
*A. porosus*, Jenyns (*Eleginops maclovinus*).
*Gobius ophicephalus*, Jenyns (*Ophiogobius ophicephalus*).
*Iluocoetes fimbriatus*, Jenyns.
*Phucocoetes latitans*, Jenyns.
*Stromateus maculatus*, Cuvier and Valenciennes.
*Agriopus hispidus*, Jenyns (*Congiopodus peruvianus*).
*Aspidophorus chiloensis*, Jenyns (*Agonopsis chiloensis*).
*Gobiesox marmoratus*, Jenyns.

The voyages of the 'Erebus' and 'Terror' to southern seas, under the command of Captain Sir J. C. Ross, during the years 1839 to 1843, led to further additions being made to the list of species known from this region. The fishes collected were described by Richardson (1844–1848) and the following species were added to the Patagonian list:

*Syngnathus hymenolomus*, Richardson (*Entelurus aequoreus*).
*Notothenia cornucola*, Richardson.
*N. virgata*, Richardson (*N. cornucola*).
*N. marginata*, Richardson (*N. cornucola*).
*N. tessellata*, Richardson.
*N. sima*, Richardson.
*Harpagifer palliolatus*, Richardson (*H. bispinis*).
*Atherina nigricans*, Richardson (*Austromenidia nigricans*).

H.M.S. 'Nassau' (1866–1869), under the command of Captain R. C. Mayne, and with R. O. Cunningham as naturalist, obtained a number of fishes from this region, which were later described by Cunningham (1871). The following additional species were obtained:

*Acanthias vulgaris*, Risso (? *A. lebruni*).
*Psammobatis rudis*, Günther (*P. scobina*).
*Callorhynchus antarcticus*, Lacepède (*C. callorhynchus*).
*Merluccius gayi*, Guichenot (*M. hubbsi*).
*Notothenia macrocephala*, Günther.
*Tripterygium* sp. (*T. cunninghami*).
*Maynea patagonica*, Cunningham.
*Atherinichthys laticlavia*, Cuvier and Valenciennes (*Austromenidia smitti*).
*A. alburnus*, Günther (*Austromenidia nigricans*).
*Sebastes oculatus*, Cuvier and Valenciennes (*Sebastodes oculatus*).

In 1871 to 1872, the 'Hassler', under the scientific direction of Louis Agassiz, and with F. Steindachner as ichthyologist, obtained some fishes from the Magellan district, which were later described by Steindachner (1876). The following names were added to the list in this paper:

*Cottoperca rosenbergii*, Steindachner (*C. gobio*).
*Notothenia longipes*, Steindachner.
*N. hassleriana*, Steindachner (*N. macrocephala*).

During the voyage of the 'Challenger' (1872–1876), under the command of Sir G. S. Nares, several stations were made in the Patagonian region. The fishes were described by Günther (1880, 1887, 1889), and the following species added to the Patagonian fauna:[1]

*Scyllium chilense*, Guichenot (*Scyliorhinus bivius*).
*S. canescens*, Günther (*Scyliorhinus canescens*).
*Centroscyllium granulatum*, Günther.
*Spinax granulosus*, Günther.
*Raja brachyura*, Günther (*R. brachyurops*).
*Macrurus fasciatus*, Günther (*Coelorhynchus fasciatus*).
*Macruronus novae-zealandiae*, Hector (*M. magellanicus*).
*Salilota australis* (Günther).
*Lotella marginata*, Günther.
*Notothenia elegans*, Günther.
*Lycodes macrops*, Günther (*Ophthalmolycus macrops*).
*Cataetyx messieri* (Günther).
*Thysanopsetta naresi*, Günther.

The S.M.S. 'Gazelle' (1874–1876), under the command of Captain F. von Schleinitz, visited the Straits of Magellan and the east coast of Patagonia. The zoological results of the voyage were edited by Studer (1889), and the following species added:

*Notothenia squamiceps*, Peters.

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[1] Some of the new species of fishes obtained by the 'Challenger' were described by Günther in a preliminary paper: 1878, *Ann. Mag. Nat. Hist.* (5) II, pp. 17–28, 179–187, 248–251.

During the years 1878–1880, the 'Alert', with Dr R. W. Coppinger as naturalist, obtained a number of fishes from the Patagonian region, which were described by Günther (1881). The following species were new to the region:

*Galaxias coppingeri*, Günther (*G. maculatus*).
*Trachurus trachurus* (Linnaeus).
*Melanostigma gelatinosum*, Günther.
*Agriopus peruvianus*, Cuvier and Valenciennes (*Congiopodus peruvianus*).
*Neophrynichthys latus*, Hutton (*N. marmoratus*).
*Hippoglossina macrops*, Steindachner (*H. mystacium*).
*H. microps*, Günther (*Paralichthys microps*).

The Italian Antarctic Expedition (1881–1882), under the command of Lieutenant G. Bove, and with Dr D. Vinciguerra as naturalist, made a collection of fishes in this region, which were later described with others from South America by Perugia (1891). Four species were added to the Patagonian list:

*Clupea arcuata*, Jenyns.
*Salilota bovei*, Perugia (? *S. australis*).
*Percichthys vinciguerrae*, Perugia.
*Genypterus blacodes* (Schneider).

The important Mission Scientifique du Cap Horn (1882–1883), with the 'Romanche' and the 'Volage' under the command of Captain Martial, made extensive collections in the Magellan district, which were reported upon by Vaillant (1888). The following species were added to the fauna:

*Acanthias lebruni*, Vaillant (*Squalus lebruni*).
*Leptonotus blainvilleanus* (Eydoux and Gervais).
*Muraenolepis orangiensis*, Vaillant.
*Notothenia squamifrons*, Günther (? *N. wiltoni*).
*N. cyanobrancha*, Richardson (? *N. brevicauda*).
*Thyrsites atun* (Euphrasen).
*Lycodes variegatus*, Günther (*Iluocoetes fimbriatus*).
*Genypterus chilensis* (Guichenot) (? *G. blacodes*).
*Seriolella porosa*, Guichenot.
*Enantioliparis pallidus*, Vaillant (*Careproctus pallidus*).
*Cyclopterichthys amissus*, Vaillant.

During the years 1887 to 1888, the United States Bureau of Fisheries steamer 'Albatross' passed by way of the Straits of Magellan from the Atlantic to the Pacific, collecting at various points en route. A number of fishes were obtained from the Patagonian region, but were untouched until reported upon by Thompson (1916). Two species were added to the list:

*Squalus fernandinus*, Molina (? *S. lebruni*).
*Coelorhynchus patagoniae*, Gilbert and Thompson.

Jordan (1891) described four species of fish from Patagonia, collected about 1888. Two of these were taken near Cape San Matios, one probably at southern Patagonia, and the last probably on the west coast of Patagonia. One only was new to this region:

*Psammobatis rutrum*, Jordan (*P. scobina*).

Professor M. L. Plate of the University of Berlin made important collections in Chile, Patagonia and Tierra del Fuego during the years 1893 to 1895, which were studied by Steindachner (1898, 1903).[1] The following species were added to the Patagonian fauna:

*Raja magellanica*, Steindachner.
*Galaxias platei*, Steindachner.
*Notothenia modesta*, Steindachner (*N. cornucola*).
*Notothenia acuta*, Günther (*N. canina*).
*Clinus geniguttatus*, Cuvier and Valenciennes (*Calliclinus geniguttatus*).
*Lycodes* (*Phucocoetes*) *platei*, Steindachner (*Austrolycus laticinctus*).
*Platea insignis*, Steindachner.

The scientific expedition to Tierra del Fuego (1895 to 1897), with the Chilean vessels 'Condor' and 'Huemul', under the direction of Dr O. Nordenskiöld, obtained a number of fishes from this region, which were described by Smitt (1897, 1899). The following were new to the region:

*Notothenia tessellata* forma *canina*, Smitt (*N. canina*).
*Dissostichus eleginoides*, Smitt.
*Tripterygium cunninghami*, Smitt.
*Phucocoetes variegatus elongatus*, Smitt (*Iluocoetes elongatus*).
*Atherinichthys regia* (Humboldt) (*Austromenidia smitti*).

The Belgian Antarctic Expedition, with the S.Y. 'Belgica' under the command of A. de Gerlache de Gomery, during the years 1897 to 1899, obtained a few fishes from the Patagonian region, which were reported upon by Dollo (1904). He records one species not previously reported from the region:

*Notothenia coriiceps*, Richardson (*N. cornucola*).

In 1899 and 1900 Mr Barnum Brown made a small collection of fishes in Patagonia and Tierra del Fuego for the American Museum of Natural History, which were dealt with by Hussakof (1914). There were no new Patagonian species in this collection.

In 1900, the late Mr Rupert Vallentin sent a few fishes from the Falkland Islands to the British Museum, which were studied by Boulenger (1900). One new species was described:

*Lycodes flavus*, Boulenger (*Phucocoetes latitans*).

The Swedish South Polar Expedition, with the 'Antarctic', under the direction of Dr O. Nordenskiöld, during the years 1901 to 1903, obtained a number of fishes from Tierra del Fuego and adjacent seas, and from the Falkland Islands and the Burdwood Bank. These were reported upon by Lönnberg (1905), and the following species added to the list:

*Muraenolepis marmoratus microps*, Lönnberg (*M. microps*).
*Macrurus* sp. (conf. *holotrachys*, Günther) (*Coelorhynchus holotrachys*).
*Notothenia brevicauda*, Lönnberg.
*N. karlandriae*, Lönnberg (*N. sima*).

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[1] The zoological results of Professor Plate's expedition were published in four supplementary volumes of the *Zoologische Jahrbücher*, under the general title of "Fauna Chilensis".

*N. brevipes*, Lönnberg (*N. tessellata*).
*Iluocoetes fimbriatus fasciatus*, Lönnberg (*Crossostomus fasciatus*).
*Liparis antarctica falklandica*, Lönnberg (*Careproctus falklandica*).

Lönnberg (1907) has also published an account of a collection of fishes from the Magellan district in the Naturhistorisches Museum at Hamburg, including specimens obtained by Captain R. Paessler (1886–1904) and those obtained by Dr W. Michaelsen with the 'Sara' (1892, 1893). The following species were new to the Patagonian region:

*Mustelus canis* (Mitchill).
*Etmopterus paessleri*, Lönnberg (*Spinax paessleri*).
*Raja oxyptera*, Philippi (*R. flavirostris*).
*Macruronus magellanicus*, Lönnberg.
*Serranus humeralis*, Cuvier and Valenciennes (*Paralabrax humeralis*).
*Cheilodactylus macropterus* (Schneider) (? *C. bergi*).
*Pinguipes chilensis* (Molina).
*Sebastodes darwini* (Cramer) (? *S. oculatus*).
*Porichthys porosus* (Cuvier and Valenciennes).

The Scottish National Antarctic Expedition (1902 to 1904), with the 'Scotia', under the direction of Mr W. S. Bruce, obtained some fishes from the Falkland Islands and the Burdwood Bank, which were reported upon by Regan (1913). The following species were added to the Patagonian list:

*Cottoperca macrophthalma*, Regan (*C. gobio*).
*Notothenia trigramma*, Regan.
*N. ramsayi*, Regan.
*N. wiltoni*, Regan.
*Austrolycus depressiceps*, Regan.

The second French Antarctic Expedition (1908 to 1910), with the 'Pourquoi Pas?', under the command of Dr Jean Charcot, collected a few fishes from the Magellan district, which were reported upon by Roule, Angel and Despax (1913). Only one new species was obtained:

*Cottoperca macrocephala*, Roule (? *C. gobio*).

Following this expedition there have been no further collections of importance made in the Patagonian region until the trawling surveys were undertaken by the Discovery Committee. There are several papers by Lahille, MacDonagh, Marini, and others, on the marine fishes of Argentina, and a few of the specimens described by these authors seem to have been collected in the northern part of the region here defined.

## LIST OF PATAGONIAN FISHES

The following list includes all the records from the Patagonian region as here delimited as far as it has been possible to trace them. Those species marked with an asterisk were not obtained by the Discovery Committee. The parallel columns on the right of each name indicate the distribution of the species, not only within the region, but in other parts of South America. *A* represents the coast of Chile north of Chiloe (i.e. outside the region); *B* covers the west coast of Patagonia south of Chiloe, the Straits of Magellan, and Tierra del Fuego; *C* covers the east coast of Patagonia as far north as Cape Blanco (i.e. to the limit of the Magellan district as defined by Regan),

| | *A* | *B* | *C* | *D* | *E* | *F* |
|---|---|---|---|---|---|---|
| *Geotria australis*, Gray | × | × | × | × | × | Australia; N. Zealand |
| *Myxine australis*, Jenyns | . | × | × | × | . | |
| *Myxine affinis*, Günther | . | × | × | . | . | |
| **Myxine tridentiger*, Garman | . | × | . | . | . | |
| *Cetorhinus maximus* (Gunner) | . | . | × | . | × | N. and S. Hemispheres |
| **Scyliorhinus* (*Halaelurus*) *canescens* (Günther) | . | × | . | . | . | |
| *Scyliorhinus* (*Halaelurus*) *bivius* (Smith) | . | × | × | × | × | |
| **Mustelus canis* (Mitchill) | . | × | . | × | × | Both sides of Atlantic |
| **Centroscyllium granulatum*, Günther[1] | . | . | × | . | . | |
| **Spinax paessleri* (Lönnberg) | . | × | . | . | . | |
| **Spinax granulosus*, Günther | . | × | . | . | . | Hawaii; S. Africa |
| *Squalus lebruni* (Vaillant) | × | × | × | . | × | Australia; N. Zealand |
| **Centroscymnis macracanthus*, Regan | . | × | . | . | . | |
| *Discopyge tschudii*, Heckel | × | . | . | × | × | |
| *Raja flavirostris*, Philippi | × | × | × | × | × | |
| *Raja doello-juradoi*, Pozzi | . | . | × | × | × | |
| *Raja macloviana*, sp.n. | . | . | × | × | . | |
| *Raja magellanica*, Steindachner | . | × | × | . | . | |
| *Raja multispinis*, sp.n. | . | . | × | . | . | |
| *Raja scaphiops*, sp.n. | . | . | × | × | . | |
| *Raja albomaculata*, sp.n. | . | . | × | . | . | |
| *Raja brachyurops*, Fowler | . | × | × | × | × ? | |
| *Raja griseocauda*, sp.n. | . | . | × | × | . | |
| *Psammobatis extenta* (Garman) | . | . | . | × | × | S. Brazil |
| *Psammobatis scobina* (Philippi) | × | × | × | × | × | |
| *Callorhynchus callorhynchus* (Linnaeus) | × | × | × | × | × | S. Brazil |
| *Clupea fuegensis*, Jenyns | . | × | × | × | . | |
| *Clupea arcuata*, Jenyns | . | × | × | × | × | |
| *Galaxias attenuatus* (Jenyns) | × | × | × | . | . | Australia; N. Zealand |
| **Galaxias maculatus* (Jenyns) | × | × | × | . | . | |
| **Galaxias alpinus* (Jenyns) | . | × | . | . | . | |
| **Galaxias platei*, Steindachner | . | × | . | . | . | |
| **Galaxias smithii*, Regan | . | . | × | . | . | |
| *Aplochiton zebra*, Jenyns | . | × | × | . | . | |
| **Aplochiton taeniatus*, Jenyns | . | × | × | . | . | |
| **Ariosoma* (?) *punctus* (Jenyns) | . | × | . | . | . | |
| *Leptonotus blainvilleanus* (Eydoux & Gervais) | × | × | . | × ? | . | |
| **Entelurus aequoreus* (Linnaeus) | . | . | × | . | . | N. and S. Atlantic; Mediterranean; North Sea, etc. |
| *Coryphaenoides holotrachys* (Günther) | . | × ? | × | × | × | |
| *Coelorhynchus fasciatus* (Günther) | . | × | × | . | . | S. Africa |
| **Coelorhynchus patagoniae*, Gilbert & Thompson | . | × | . | . | . | |
| *Merluccius hubbsi*, Marini | . | × | × | × | × | |
| **Merluccius australis* (Hutton) | . | × | . | . | . | N. Zealand |
| *Macruronus magellanicus*, Lönnberg | . | × | × | × | × | |
| *Micromesistius australis*, sp.n. | . | . | × | × | . | |
| *Salilota australis* (Günther) | . | × | × | × | . | |
| *Physiculus marginatus* (Günther) | . | × | × | . | . | |
| *Muraenolepis microps*, Lönnberg | . | . | × | . | . | S. Georgia; Antarctic |
| *Muraenolepis orangiensis*, Vaillant | . | × | × | . | . | |
| *Lampris regius* (Bonnaterre) | . | . | × | . | . | Atlantic; Pacific |
| **Percichthys trucha* (Cuvier & Valenciennes) | × | × | . | . | . | |
| **Percichthys vinciguerrae*, Perugia | . | × | . | . | . | |

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[1] Perhaps identical with *C. fabricii* (Reinhardt), from the North Atlantic and North Pacific.

| | *A* | *B* | *C* | *D* | *E* | *F* |
|---|---|---|---|---|---|---|
| **Alphestes afer* (Bloch) | . | . | × | . | . | W. Indies; Brazil |
| **Paralabrax humeralis* (Cuvier & Valenciennes) | × | × | . | . | . | |
| **Trachurus trachurus* (Linnaeus) | × ? | × | . | . | × | Atlantic; Pacific(?) |
| *Parona signata* (Jenyns) | . | . | × | × | × | S. Brazil |
| **Cilus montti*, Delfin[1] | × | × | . | . | . | |
| *Cheilodactylus bergi*, sp.n. | . | . | × ? | × | × | Brazil |
| **Latris hecateia*, Richardson[2] | . | × | . | . | . | Australia; N. Zealand |
| **Pinguipes chilensis* (Molina) | × | × | . | . | . | |
| *Cottoperca gobio* (Günther) | . | × | × | × | × | |
| **Bovichtus argentinus*, MacDonagh | . | . | . | × | × | |
| *Notothenia macrophthalma*, sp.n. | . | . | × | . | . | |
| **Notothenia trigramma*, Regan | . | . | × | . | . | |
| *Notothenia canina*, Smitt | . | × | × | . | . | |
| *Notothenia jordani*, Thompson | . | × | × | . | . | |
| *Notothenia tessellata*, Richardson | . | × | × | . | . | |
| *Notothenia brevicauda*, Lönnberg | . | × | × | . | . | |
| *Notothenia guntheri*, sp.n. | . | . | × | . | . | |
| *Notothenia ramsayi*, Regan | . | . | × | × | . | |
| *Notothenia wiltoni*, Regan | . | × | × | × | × | |
| *Notothenia longipes*, Steindachner | . | × | . | . | . | |
| *Notothenia squamiceps*, Peters | . | × | × | . | . | |
| *Notothenia sima*, Richardson | . | × | × | . | . | |
| *Notothenia cornucola*, Richardson | . | × | × | . | . | |
| *Notothenia elegans*, Günther | . | × | × | × | . | |
| *Notothenia macrocephala*, Günther | × | × | × | . | . | Kerguelen; N. Zealand, etc. |
| **Notothenia microlepidota*, Hutton | . | × | . | × | . | N. Zealand, etc. |
| *Dissostichus eleginoides*, Smitt | . | × | × | . | × | Graham Land |
| *Eleginops maclovinus* (Cuvier & Valenciennes) | × | × | × | × | × | |
| *Harpagifer bispinis* (Schneider) | . | × | × | . | . | S. Georgia; Antarctic; Kerguelen; Marion Is., Macquarie I., etc. |
| *Champsocephalus esox* (Günther) | . | × | × | . | . | |
| *Thyrsites atun* (Euphrasen) | × | × | × | × | × | S. Africa; Tristan da Cunha; Australia; N. Zealand |
| *Gasterochisma melampus*, Richardson | . | . | × | . | × | S. Atlantic; S. Pacific |
| **Ophiogobius ophicephalus* (Jenyns) | × | × | . | . | . | |
| **Heterogobius* (?) *chiloensis* (Guichenot) | . | × | . | . | . | |
| **Calliclinus geniguttatus* (Cuvier & Valenciennes) | × | × | . | . | . | |
| **Tripterygium cunninghami*, Smitt | . | × | . | . | . | |
| **Ophthalmolycus macrops* (Günther) | . | × | . | . | . | |
| *Iluocoetes fimbriatus* (Jenyns) | . | × | × | × | × | |
| *Iluocoetes elongatus* (Smitt) | . | . | × | × | . | |
| *Austrolycus depressiceps*, Regan | . | × | × | . | . | |
| *Austrolycus laticinctus* (Berg) | . | × | × | . | × ? | |
| *Phucocoetes latitans*, Jenyns | . | . | × | . | . | |
| **Crossostomus chilensis* (Regan) | . | × | . | . | . | |
| **Crossostomus fasciatus* (Lönnberg) | . | . | × | . | . | |
| *Pogonolycus elegans*, sp.n. | . | . | × | . | . | |
| *Platea insignis*, Steindachner | . | × | × | . | × | |
| **Maynea patagonica*, Cunningham | . | × | × | . | . | |
| *Maynea brevis*, sp.n. | . | . | × | × | . | |

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[1] Delfin, 1901, *Cat. Peces Chile*, p. 67.

[2] Delfin, 1901, *t.c.*, p. 73.

| | *A* | *B* | *C* | *D* | *E* | *F* |
|---|---|---|---|---|---|---|
| **Melanostigma gelatinosum*, Günther | . | × | . | . | . | |
| *Melanostigma microphthalmus*, sp.n. | . | . | × | . | . | |
| *Lycodapus australis*, sp.n. | . | × | . | . | . | |
| *Genypterus blacodes* (Schneider) | . | × | × | × | × | Australia; N. Zealand |
| *Cataetyx messieri* (Günther) | . | × | × | × | . | S. Africa |
| *Seriolella porosa*, Guichenot | × | × | × | × | . | Australia; N. Zealand |
| *Palinurichthys caeruleus* (Guichenot) | . | . | × | . | . | Juan Fernandez |
| *Palinurichthys griseolineatus*, sp.n. | . | . | × | . | . | |
| *Stromateus maculatus*, Cuvier & Valenciennes | × | × | × | × | × | |
| *Austromenidia smitti* (Lahille) | . | × | × | × | × | |
| *Austromenidia nigricans* (Richardson) | . | × | × | . | . | |
| *Sebastodes oculatus* (Cuvier & Valenciennes) | × | × | × | . | . | |
| *Congiopodus peruvianus* (Cuvier & Valenciennes) | × | × | × | × | × | |
| **Bunocottus apus*,[1] Kner | . | . | × | . | . | |
| *Neophrynichthys marmoratus*, Gill | . | × | × | . | × | |
| *Agonopsis chiloensis* (Jenyns) | × | × | × | × | × | |
| **Cyclopterichthys amissus*, Vaillant | . | × | . | . | . | |
| *Careproctus falklandica*, Lönnberg | . | × | × | . | . | |
| **Careproctus pallidus* (Vaillant) | . | × | . | . | . | |
| **Liparis antarctica*, Putnam | . | . | × | . | . | |
| *Thysanopsetta naresi*, Günther | × | × | × | × | . | |
| **Hippoglossina mystacium*, Ginsburg | . | × | . | . | . | |
| *Paralichthys microps* (Günther) | × | × | . | . | . | |
| *Paralichthys isosceles*, Jordan | . | . | . | × | × | |
| *Xystreurys rasile* (Jordan) | . | . | . | × | × | S. Brazil |
| *Mancopsetta maculata* (Günther) | . | . | × | . | . | Nr. Prince Edward's I., Indian Ocean |
| *Achiropsetta tricholepis*, Norman | . | . | × | . | . | |
| **Gobiesox marmoratus*, Jenyns | × | × | . | . | . | |
| **Porichthys porosus* (Cuvier & Valenciennes) | × | × | . | . | . | |

[1] The presence of a member of the family Cottidae in this region is curious. Kner's species is known only from the unique holotype (about 65 mm.), said to be from the Burdwood Bank. According to Kner the pelvic fins are entirely wanting, but his figure shows a well-developed pelvic fin (1868, *SitzBer. Akad. Wiss. Wien*, LVIII (1), p. 316, pl. iii, fig. 9).

the Falkland Islands and the Burdwood Bank; *D* covers the remainder of the east coast from Cape Blanco to the San José Peninsula; *E* covers the coasts of Argentina and Uruguay; and *F* covers the distribution outside South America.

After this report had been sent to press, my attention was drawn to the following paper dealing with the marine fishes of Argentina: Pozzi, A. J. and Bordale, L. F., "Cuadro sistemático de los peces marinos de la Republica Argentina", *Anal. Soc. cient. Argent.*, CXX (4), 1935, pp. 145–89, 1 map. The authors provide a complete list of the species found on the whole of the Argentine coast, and give the latitudinal range of each species (e.g. 35°–56° S.). I have gone through this list carefully, and find that the following species, not included in my own list of the Patagonian fishes, have been recorded from south of latitude 42° S.:

*Squalus acanthias* (Linnaeus), 39°–52° 30′ S.
*Echinorhinus spinosus* (Gmelin), 35°–56° S.

*Tachysurus barbus* (Lacepède), 35°–52° S.
*Syngnathus acicularis*, Jenyns, 35°–52° S.
*Hippocampus punctulatus*, Guichenot, 35°–43° 30′ S.
*Pinguipes fasciatus*, Jenyns, 35°–43° S.
*Paralichthys brasiliensis* (Ranzani), 35°–44° S.
*Paralichthys patagonicus* (Jordan and Goss), 37°–44° S.
*Oncopterus darwini*, Steindachner, 35°–44° S.

## NOTES ON THE FISH FAUNA

The number of species recorded from the Patagonian region as here delimited is 128, and of these 85 (about 65 per cent) were obtained by the Discovery Committee's ships. A study of the list given above shows that, of the 128 species, 67 (52 per cent) are apparently confined to the region, although it must be admitted that careful collecting on the little-known coastal region of Argentina between the mouth of the Rio Plata and the San José Peninsula would probably greatly increase the list of species which extend northwards on this coast. A further 39 species are known to extend outside the region along the coasts of Chile or Argentina, but do not occur elsewhere, so that no less than 106 species (about 83 per cent) are inhabitants of the temperate and sub-Antarctic coasts of South America. Of the remaining 22 species, 7 occur also in Australia and New Zealand, 2 in New Zealand only, and 4 in South Africa. Only 3 species (*Muraenolepis microps*, *Dissostichus eleginoides*, *Harpagifer bispinis*) are found also in South Georgia or in Graham Land.

Leaving out of account the more widely distributed and often semi-oceanic fishes such as *Cetorhinus*, *Trachurus*, *Gasterochisma*, and the deep-water Sharks of the family Squalidae, the fish fauna of the Patagonian region may be roughly grouped into three categories. These are:

(1) Argentine or Chilean forms.

(2) More or less cosmopolitan genera with representatives in both the Northern and Southern Hemispheres.

(3) Forms that are peculiar to the sub-Antarctic and Antarctic Zones (e.g. Nototheniidae, Zoarcidae).

Characteristic genera in the second category are: *Myxine*, *Squalus*, *Raja*, *Clupea*, *Merluccius* and *Micromesistius*. It is of interest to note that some of the species of these genera can be paired off, as it were, with related species in the Northern Hemisphere, sometimes well separated, sometimes so closely related that it is a matter of difficulty to separate the two forms. Such pairs are: *Myxine australis* and *M. glutinosa*, *Squalus lebruni* and *S. acanthias*, *Raja flavirostris* and *R. batis*, *Raja doello-juradoi* and *R. radiata*, *Clupea fuegensis* and *C. harengus*, *Clupea arcuata* and *C. sprattus*, *Merluccius hubbsi* and *M. merluccius*, *Micromesistius australis* and *M. poutassou*. The close relationship of some of these pairs of species suggests the possibility of some fairly recent interchange between the faunas of the North Temperate and South Temperate Zones, and, as Regan[1] has pointed out when discussing the geographical distribution of the genus

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[1] 1916, *Ann. Mag. Nat. Hist.* (8) XVIII, p. 15.

*Sardina*, there is good evidence that the limits of these zones have fluctuated considerably in comparatively recent times. He points out that fishes which descend to considerable depths are less likely than shallow-water species to find the Tropical Zone an impassable barrier, and, in this connection, it may be noted that almost all the fishes listed in pairs above are known to occur (at least at times) in comparatively deep water.

With regard to the fishes of the last category, the families of special importance are the following: Muraenolepidae, Bovichthyidae, Nototheniidae, Chaenichthyidae and Zoarcidae. Regan[1] has already dealt with these in his discussion of the Magellan district, and his conclusions, with very slight modifications, have been confirmed by my own work.

MURAENOLEPIDAE. *Muraenolepis orangiensis* is confined to the Patagonian region. *M. microps* occurs on the Burdwood Bank, south of the Falkland Islands and also at South Georgia, the South Sandwich Islands, and off new land south of the Balleny Islands. A third species, *M. marmoratus*, is found at Kerguelen.

BOVICHTHYIDAE. The genus *Cottoperca* is characteristic of this region, but the single species extends northwards on the coast of Argentina. A species of *Bovichthys* (*B. argentinus*) has recently been described from the Golfo Nuevo (just south of the San José Peninsula) and from the Golfo San Jorge (about latitude 46° S).

NOTOTHENIIDAE. The characteristic Antarctic genera *Trematomus* and *Pleuragramma*, and the Harpagiferinae, except *Harpagifer bispinis*, are absent. *Eleginops maclovinus* ranges northwards to Valparaiso on the west coast and to Buenos Aires on the east. *Dissostichus eleginoides* ranges northwards on the coast of Argentina to the Rio Plata and southwards to Graham Land. What has been described by Regan as the *tessellata* group of *Notothenia*, a natural group of eleven species, comprising all those with the upper surface and sides of the head, except the snout and the praeorbital, scaled, and with a rather broad interorbital region, is peculiar to this area. Two species of another type, with the opercles scaled on the upper part of the operculum only, and with the upper surface of the head naked (*N. cornucola*, *N. elegans*), are not found elsewhere, and two other species of the same group but with a reduced number of anal rays (*N. macrocephala*, *N. microlepidota*) occur also in the Antipodes district. Finally, there is one species (*N. macrophthalma*) from near the Burdwood Bank, which has not been recorded elsewhere but which is very closely related to *N. squamifrons* from Kerguelen.

CHAENICHTHYIDAE. Represented in this region by *Champsocephalus esox*. This species does not occur elsewhere, but the genus contains one other species from South Georgia.

ZOARCIDAE. *Iluocoetes* and *Austrolycus* each have one species peculiar to the region and another which appears to extend northwards along the coast of Argentina. *Phucocoetes* (1 species), *Crossostomus* (2 species) and *Pogonolycus* (1 species) are peculiar; the single species of *Platea* extends northwards on the Argentine coast. *Ophthalmolycus* has one species here and one in the Antarctic, and *Maynea* has two here and one in the Antarctic.

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[1] 1914, *Rep. Brit. Antarct.* ('*Terra Nova*') *Exped.* 1910, Zool. 1, p. 37.

Regan[1] has made the following remarks with regard to the Kerguelen District. "At the first glance it may seem that as so many characteristic Antarctic genera appear to be absent and most of the Nototheniidae belong to *Notothenia*, which is well represented in the sub-Antarctic Zone, the Kerguelen District might be included in the latter. But a more critical examination shows that the *tessellata* group, characteristic of Magellan, is absent, that the *squamifrons*, *acuta* and *marionensis* groups are present and are found elsewhere only in the Glacial District, and that the *coriiceps* group is represented by *N. coriiceps*, an Antarctic species, and by the related *N. cyaneobrancha*. The only way to mark the dissimilarity of the fish-fauna of Kerguelen from that of Magellan or of the sub-Antarctic islands of New Zealand and to express its affinity to that of Antarctica is to include it in the Antarctic Zone as a separate district, small and impoverished, but with well-marked characters."

A closer study of the fish-fauna of the Patagonian region has shown that the dissimilarity between this and that of Kerguelen is not so marked, and that the latter has several features in common with the Patagonian region as well as with Antarctica. Two species of *Raja* occur at Kerguelen: one (*R. murrayi*) is related to the Patagonian *R. macloviana*, and the other (*R. eatonii*) is related to the Patagonian *R. scaphiops*. *Muraenolepis marmoratus* is related to *M. microps* and *M. orangiensis*, both of which occur in the Magellan District. The 'William Scoresby' obtained a single specimen of a new species of *Notothenia* from deep water near the Burdwood Bank, which is very closely related to *N. squamifrons* from Kerguelen. *Notothenia macrocephala* has now been recorded from Kerguelen,[2] and this species occurs also in the Patagonian region and in the Antipodes District but not in the Glacial District. *Harpagifer bispinis* is also common to Kerguelen and the Patagonian region, but occurs in the Antarctic Zone.

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[1] 1914, *t.c.*, p. 36.

[2] Regan, 1916, *Ann. Mag. Nat. Hist.* (8) XVIII, p. 378. See also, Waite, 1916, *Austral. Antarct. Exped.*, Fishes (*Sci. Rep.* Ser. C, III, 1), p. 69.

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# PLATE I

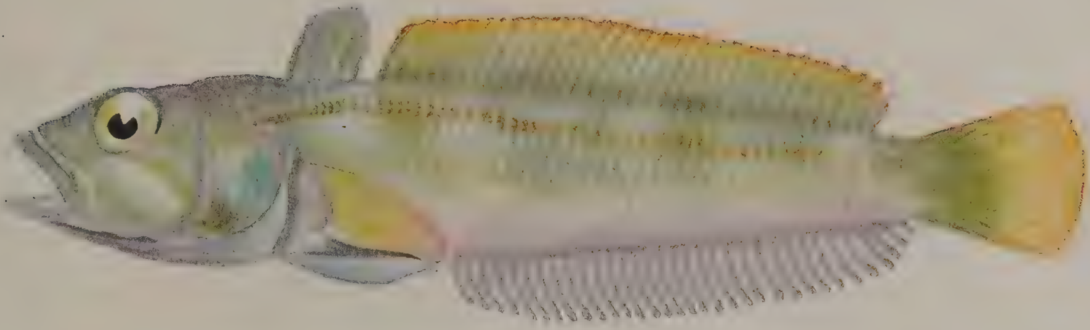
Sketches of Patagonian fishes made from life by Mr E. R. Gunther.

Fig. 1. *Notothenia guntheri* (× $\frac{7}{8}$).

Fig. 2. *Notothenia ramsayi* (× $\frac{7}{8}$).

Fig. 3. *Pogonolycus elegans* (× 2).

Fig. 4. *Iluocoetes fimbriatus* (× $\frac{1}{2}$).



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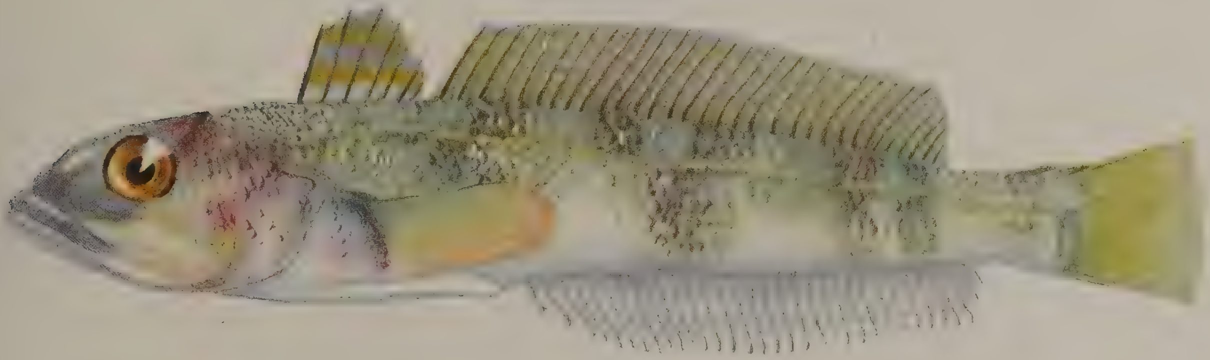

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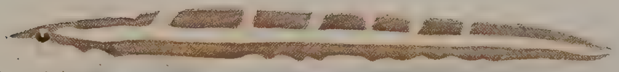

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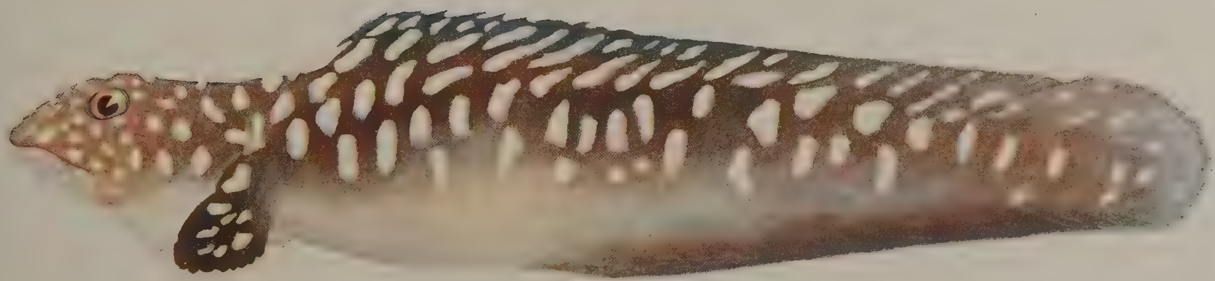

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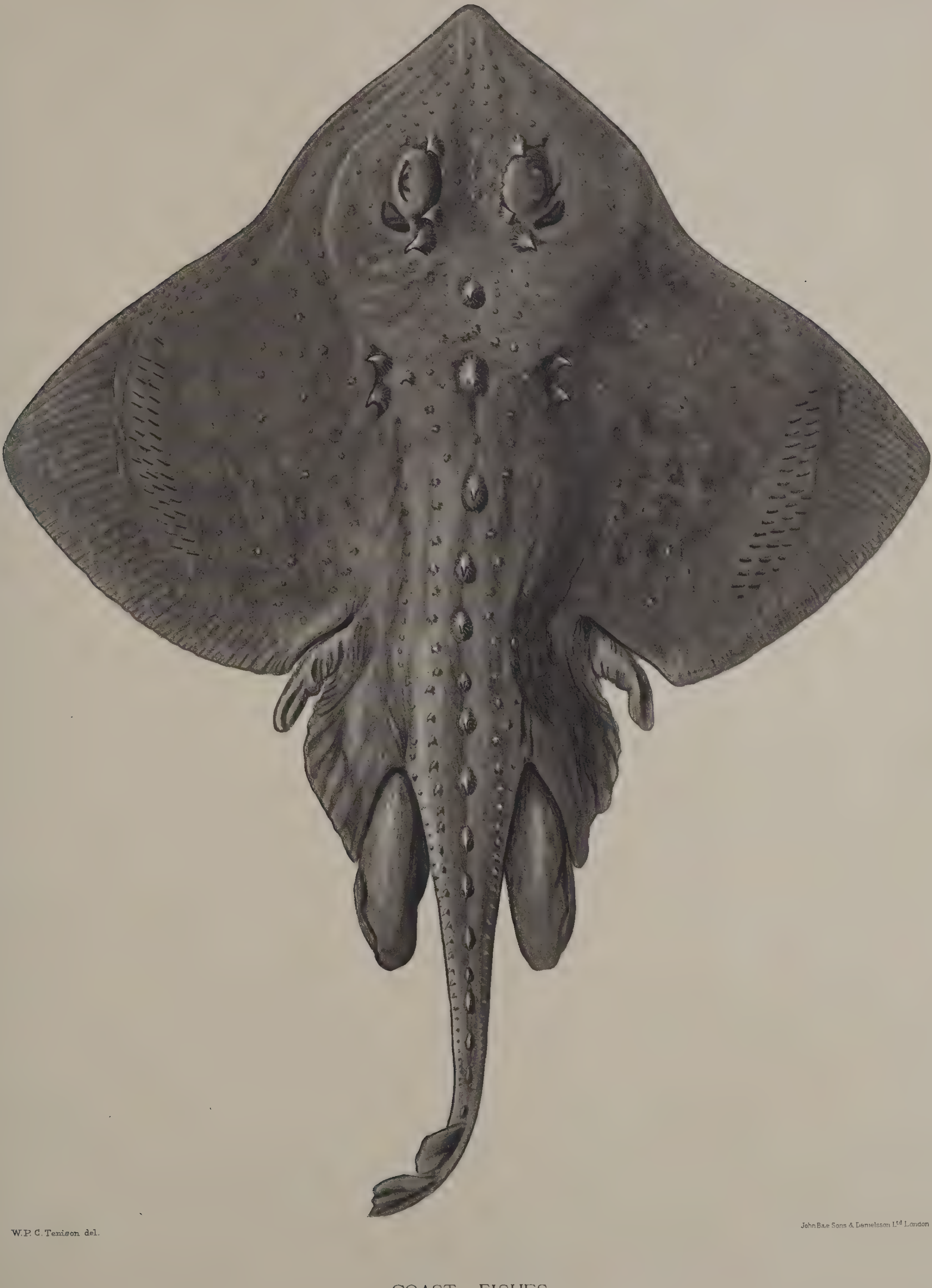
## PLATE II

*Raja doello-juradoi.* Male (× about ½).



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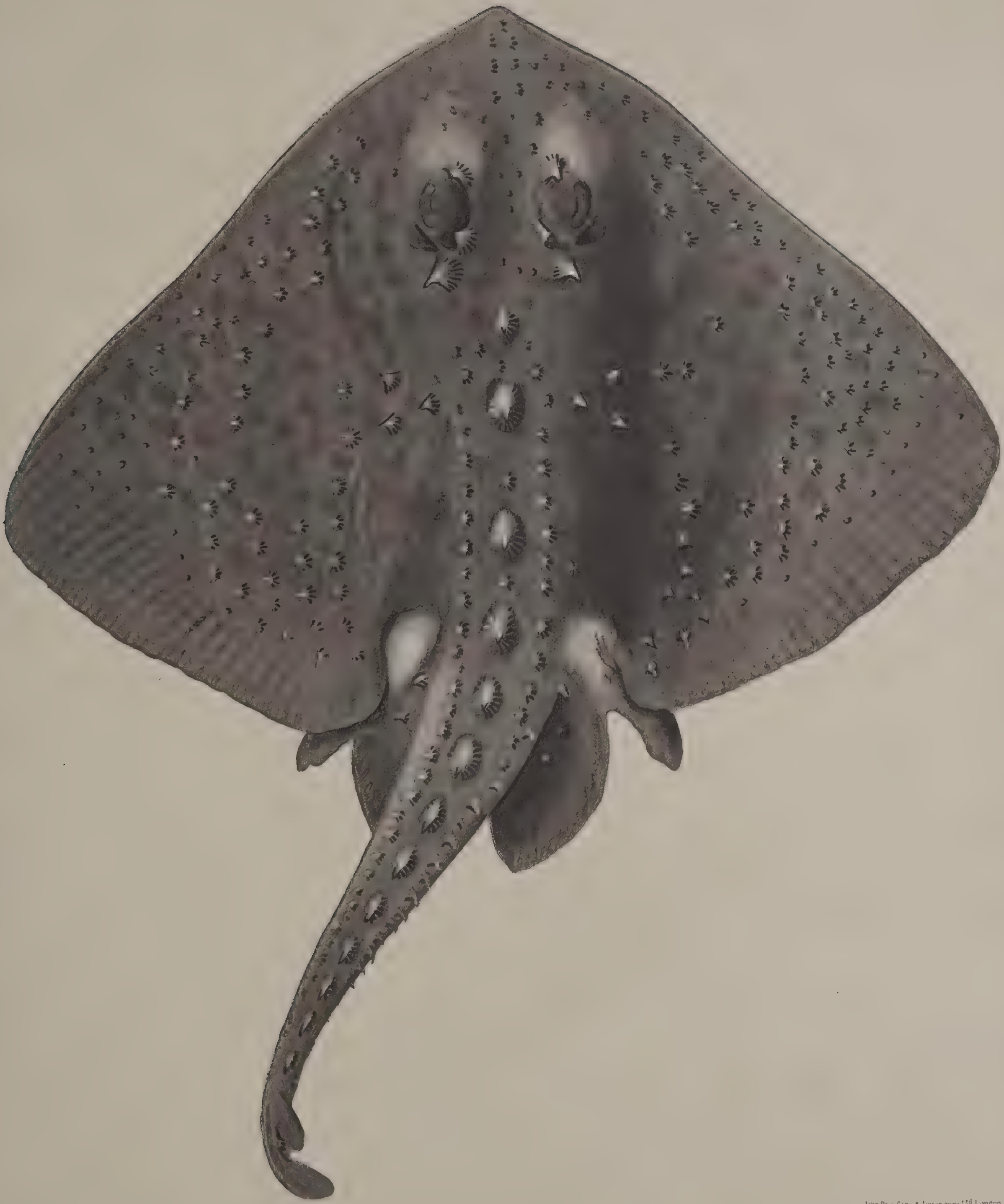
## PLATE III

*Raja doello-juradoi.* Female ( × about $\frac{4}{5}$).



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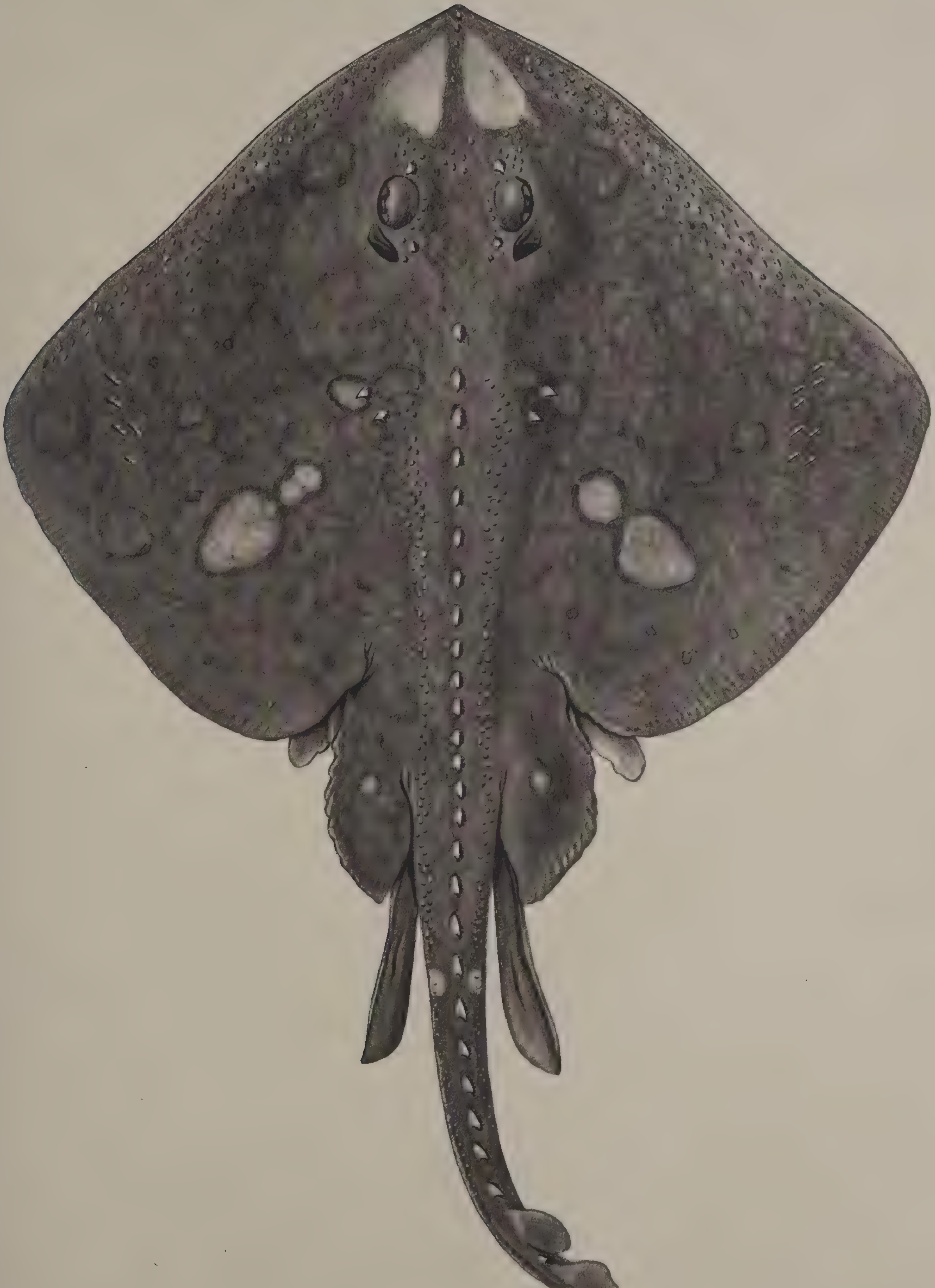
## PLATE IV

*Raja magellanica* (× about $\frac{1}{2}$).



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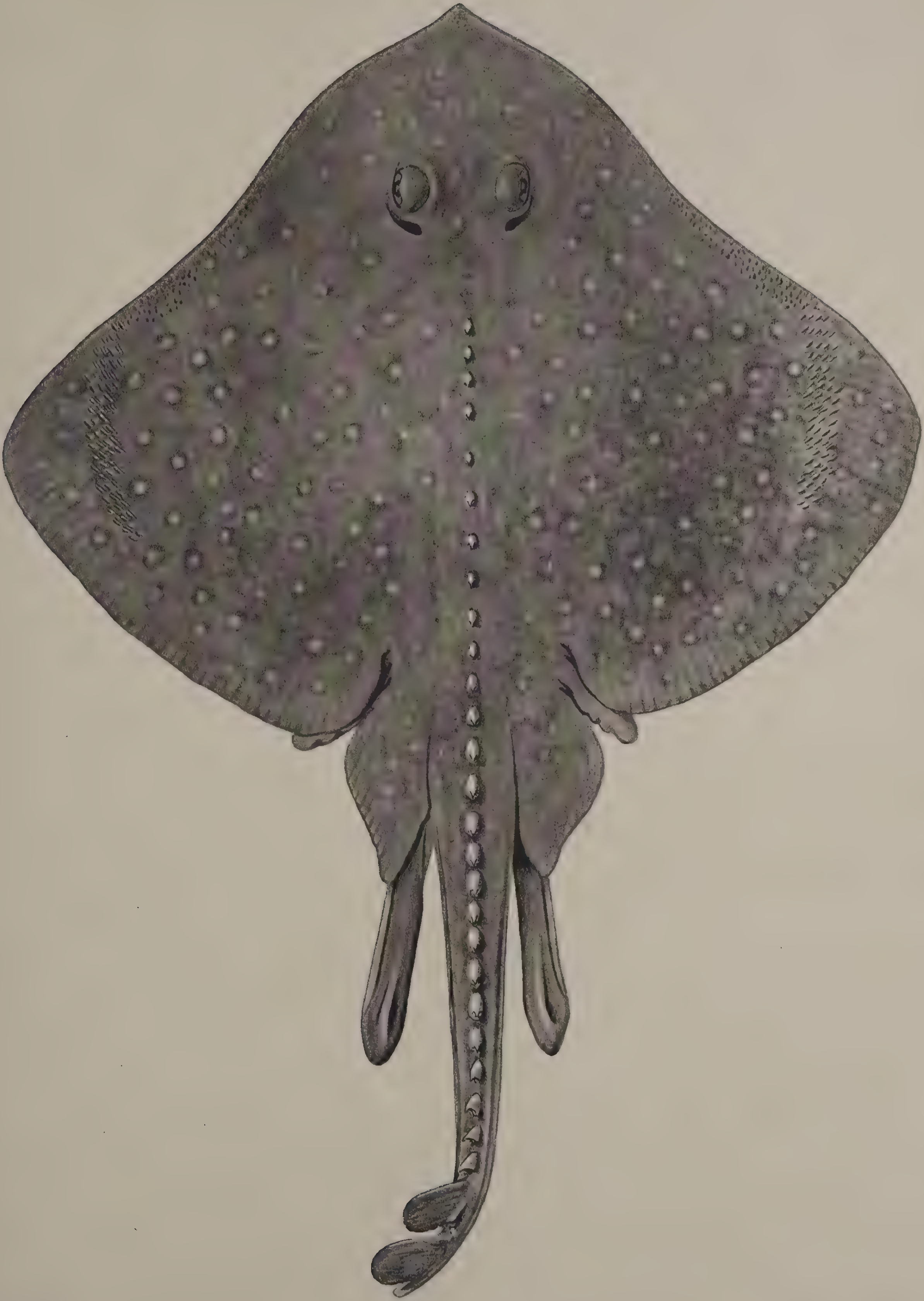
## PLATE V

*Raja albomaculata* ( × about $\frac{2}{5}$).



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[*Discovery Reports. Vol. XVI, pp.* 151–364, *Plates VI–XIII, April,* 1937.]

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# THE PLANKTON DIATOMS OF THE SOUTHERN SEAS

By

N. INGRAM HENDEY, F.L.S., F.R.M.S.

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# THE PLANKTON DIATOMS OF THE SOUTHERN SEAS

By N. Ingram Hendey, F.L.S., F.R.M.S.

(Text-figs. 1–3; Plates VI–XIII)

## INTRODUCTION

THE amount of phytoplankton material obtained during the Discovery Committee's investigations is so enormous that it was decided that a complete analysis of all the available material, apart from being an almost unsurmountable task, would serve no useful purpose in compiling a systematic account of the species of diatoms. A survey of all the material in hand at the time of writing was therefore made, and lines of stations from many different and widely spread areas were selected in order to provide as complete a picture as possible of the diatom population south of the Equator. Although the majority of the material was obtained from the Southern Ocean between 50 and 65° S, and 10 and 70° W, and particularly from the neighbourhood of South Georgia, many lines of stations were made in other parts that yielded a wealth of material quite unsurpassed heretofore.

The material selected for this work comes from many stations around South Georgia, the South Sandwich Islands, the South Shetlands, and the Bransfield Strait. Several stations in the Weddell Sea and the Bellingshausen Sea provided information concerning those diatoms which live under truly Antarctic conditions. A line of stations from the Falkland Islands to the mainland, together with several stations off the Brazil coast, provided information concerning the diatom flora of the south-western Atlantic. Other Atlantic material was obtained from a line of stations along the 30th W meridian from the east of the Sandwich Group to the Cape Verde Islands, and several stations off the west coast of Africa. Numerous lines of stations radiating from South Africa were selected, and a number of isolated stations much farther south, between the Cape and Enderby Land. Facts concerning the diatom flora of the Indian Ocean, particularly the neritic species, were obtained from nets taken on a line of stations along the east coast of Africa from the Cape almost to Aden, made upon the homeward journey of the 'Discovery II' during the 1933–5 commission. The diatom flora supported by the Peru Current off the west coast of South America was sampled during the work of the 'William Scoresby' in 1931, and material obtained from a line of over forty stations from the Straits of Magellan to the Equator was examined. This material was very rich in neritic forms. Two other sources of material may be mentioned, although their yield was very small, the first being the diatoms obtained from melted ice taken in the Bellingshausen Sea, the second consisting of those found in the skin film of certain species of whales.

The great advantage of examining material from such a variety of localities is that one is able to study the diatom population in its broader aspects and in so doing to avoid much of the error that has occurred in systematic work because of a too critical study of museum specimens; the population can be considered as a biological community, which exists at the mercy of an environment whose chemical and physical factors are liable to continual change.

Interesting phenomena present themselves for consideration, such as the reaction of organisms to their environment—the most important factor that controls geographical distribution of species. Special modifications of form and methods of adaption, such as the production of peripheral air chambers to increase buoyancy in tropical waters, or the production of spines and bristles for increased stability in forms which have to undergo the buffeting of a truly oceanic existence, throw interesting light on the "rigidity" or "plasticity" of species.

This plasticity, which is observed in all the truly planktonic genera, may be a feature of some specialized part of the organism, or may take its origin in something deeper and more fundamental. It is not yet known whether these structural modifications are accompanied by or are the result of changes which take place in the cytological elements. This field of research is entirely unexplored.

Facts concerning the growth and extent of the algal population of the surface waters in the southern seas have been dealt with by Dr Hart (1934), but the problem might also be considered from the points of view of Verhulst, and Pearl and Reed. These views have been ably expounded and extended by Longley (1932), who seeks to explain biological populations in terms homologous with the laws of gases, and suggests that they are equally capable of mathematical expression.

In considering the factors which govern the phenomenal increase in southern phytoplankton during certain seasons of the year attention must be paid to the chemical and physical constitution of the water. In striking contrast to tropical and subtropical areas, where extreme paucity in individuals is probably accounted for by the fact that the surface waters are almost entirely devoid of nutrient mineral salts, the waters in polar and subpolar areas never become completely exhausted of their store of inorganic food, and become supercharged with salts every spring, with the breaking up of the ice fields, and the influx of new water.

Hart (1934) has shown that the phosphate content of water in the more northerly parts of the Antarctic Zone never falls below 50 mg. per cubic metre, and he has suggested that the nutrient salts cannot be regarded at any time as a factor limiting phytoplankton growth or controlling periodicity. There is, however, the possibility that shortage of silica may sometimes limit diatom growth in the northern parts of the Antarctic Zone.

The interesting and highly provocative work of H. T. Barnes (1928) might also be considered in this connection. Barnes utilized the work of Bayliss (1927) who showed that water must be regarded as a system of polymers, that the degree of polymerization is roughly inversely proportional to the temperature, and that the differences in state are due to the varying proportions of the polymers present. In steam, monohydrol preponderates; in ice, trihydrol. Later, T. C. Barnes (1932) was able to show that in a culture of the freshwater alga *Spirogyra*, marked increase in growth occurred when ice water had been added to the culture medium, and H. W. Harvey (1933), working with cultures of *Nitzschia closterium*, has shown that the addition of ice water and the consequent increase in the proportion of trihydrol greatly stimulated growth.

In considering periodicity it is interesting to note that the enormous increase in diatom production is observed in areas which are under the influence of melting ice, and it is probable that the extreme cold of the high latitudes maintains a high proportion of trihydrol in the oceans which exerts a profound influence upon the phytoplankton. Unquestionably the chemical and physical factors of the environment control the extent and distribution of the algal flora and play an important part in the variation and evolution of the species.

The samples were obtained by making vertical hauls with a plankton net through depths of either 50, 100, or 200 m. The net most frequently used in the collection of phytoplankton has a diameter of 50 cm., and is made of the finest bolting silk having 200 meshes to the linear inch. The net tapers to a diameter of 6 cm. where it joins a small canvas collar for attachment to the collecting bucket, which is secured by a brass band and a tightening screw. The entire length of the net is 5 ft. 5 in. A detailed description of this net and the methods of working are given in *Discovery Reports*, I, pp. 182–4 (1929).

The samples collected were preserved either in ½-lb. glass jars fitted with metal screw-caps or in a number of glass tubes plugged with cotton-wool and tissue paper. The tubes, in numbers varying from two to ten, were placed in a large glass jar and packed with absorbent cotton or tissue paper to prevent breakage. The material was preserved by the addition of a solution of formalin, in proportions which varied with the density of the catch.

The following table, which shows in parts per cent the variation of the populations found at 15 stations on the 30th W meridian, from 57° 36′ S to 14° 27¼′ N, is taken from Hart (1934). The enormous preponderance of diatoms in the polar waters and their scarcity in tropical waters are clearly demonstrated.

| St. No. | Position | Diatoms | Dinoflagellates |
|---|---|---|---|
| 661 | 57° 36′ S, 29° 54½′ W | 99·88 | 0·12 |
| 663 | 53° 34½′ S, 30° 25¾′ W | 100·00 | — |
| 666 | 49° 58¾′ S, 29° 52½′ W | 98·42 | 1·58 |
| 670 | 44° 52′ S, 30° 17′ W | 89·09 | 10·91 |
| 671 | 43° 08′ S, 30° 15¾′ W | 76·99 | 23·01 |
| 673 | 38° 10½′ S, 30° 10¼′ W | 26·67 | 53·33 |
| 675 | 34° 08′ S, 29° 50½′ W | — | 100·00 |
| 677 | 31° 16¼′ S, 29° 56½′ W | 35·00 | 65·00 |
| 679 | 26° 06½′ S, 30° 06¼′ W | 81·53 | 18·47 |
| 681 | 21° 13′ S, 29° 55¼′ W | 20·83 | 79·17 |
| 684 | 15° 37′ S, 29° 53½′ W | 8·69 | 78·26 |
| 687 | 9° 47′ S, 29° 51′ W | 26·00 | 74·00 |
| 690 | 3° 17¾′ S, 29° 57¾′ W | 2·98 | 22·39 |
| 693 | 2° 59½′ N, 29° 59′ W | 7·11 | 6·05 |
| 699 | 14° 27¼′ N, 30° 02¼′ W | 12·31 | 69·23 |

Many samples of the plankton from the tropical and subtropical Zones contained large numbers of small crustaceans together with many species of dinoflagellates, tunicates and ciliates.

The chief representatives of the dinoflagellates were *Ornithocercus* spp., *Ceratium tripos* and varieties, *C. fusus*, *C. azoricum*, *C. bucephalum*, *Goniaulax* spp. and *Peridinium* spp.

The ciliates belonged to the suborder Tintinnoinea, and the following genera were well represented: *Epiplocylis*, *Tintinnus*, *Parundella*, *Rhabdonella*, *Rhabdonellopsis* and *Xystonella*.

It is difficult to assess the value of the analysis of a plankton sample, particularly if obtained by means of a vertical haul, and it can in no way be regarded as representing the true population of any given area. The presence or absence of any particular species in a sample must be regarded as fortuitous to a high degree. This is particularly true of samples taken at tropical or subtropical stations, where the total volume of the phytoplankton is small and the number of diatoms per sample very few, while the number of species present is usually relatively high. In polar areas where the diatom population is in great preponderance, and species relatively few, the analyses of samples taken from a number of stations in close proximity would produce fairly constant results.

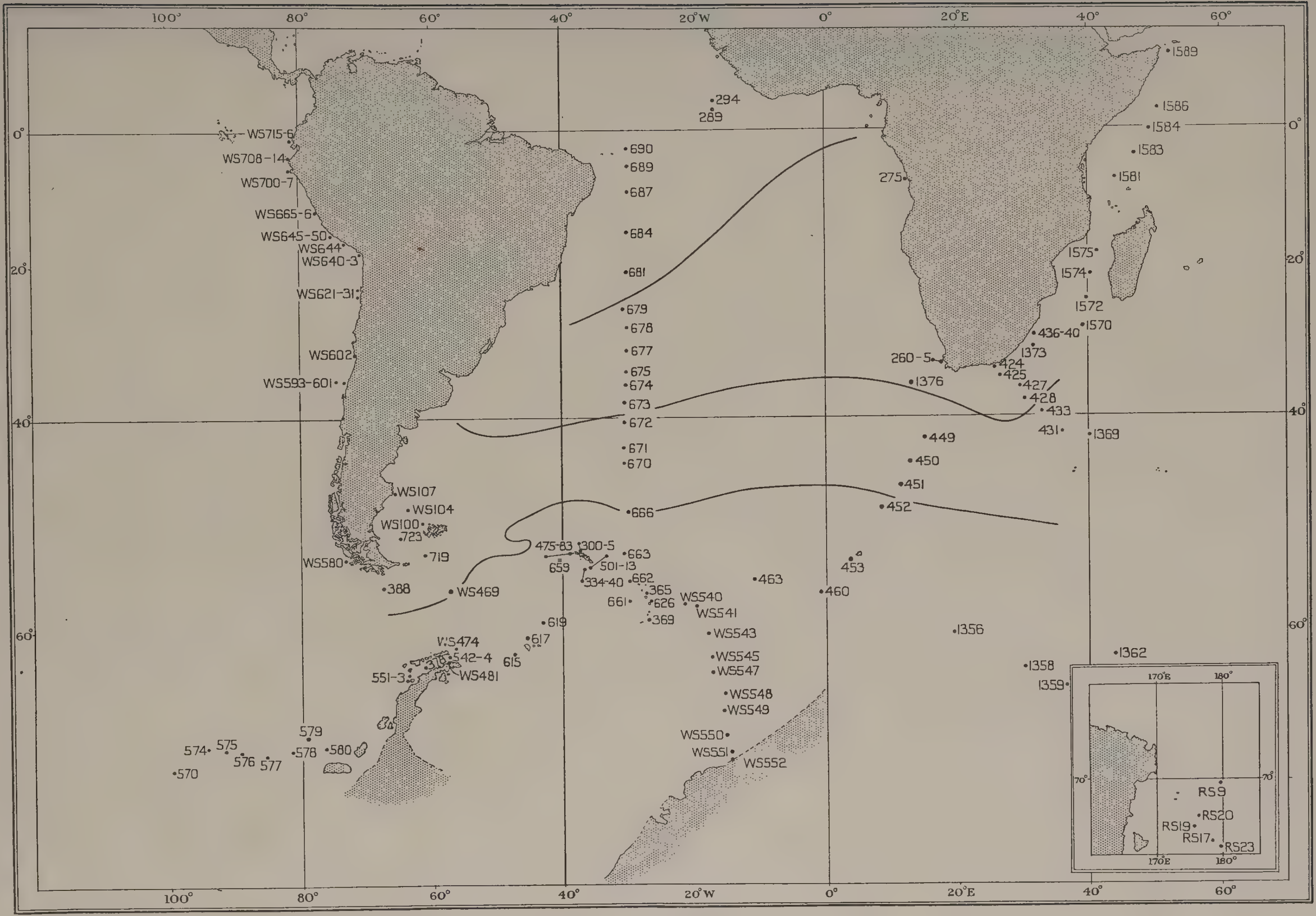
Due consideration must be given to these points when analytical results of different stations within the same zone are compared.

The dominance of the dinoflagellates, ciliates and crustaceans was well maintained to as far south as 44° S, where a marked increase in the proportion of the diatoms was noticed. St. 666 in latitude 49° 58¾′ S showed a great variety of diatoms and a decrease in the number of individuals and species of the flagellate-ciliate association, but the crustacean population suffered little loss of representatives. At St. 663, however, crustaceans were encountered but rarely, and an entirely different diatom population became dominant. The volume of the samples at all stations south of St. 663 showed great increase, and the characteristic *Corethron-Chaetoceros* associations frequently amounted to over 90 per cent of the total phytoplankton.

When this work was first undertaken it became quite clear that an examination of all the available Atlantic material was out of the question. But the utilization of certain hydrological data made it possible to divide the ocean into geographical areas which may be dealt with independently. In order to appreciate the general plan of the work it is necessary briefly to consider the data.

According to Deacon's paper (1933) the surface waters of the South Atlantic Ocean may be divided into four distinct geographical zones which differ from one another in temperature, salinity, and other factors. These zones are comparatively sharply defined and marked differences in temperature and salinity are recorded when crossing a convergence from one zone to another.

The Antarctic Zone extends from the ice shelf to the Antarctic convergence, which reaches as far north as approximately 47° 40′ S in the meridian of Greenwich, falling slightly southwards towards 30° E. To the west it passes between the Falkland Islands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WS665-6
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170°E
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70°
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RS20
RS19
RS17
RS23

Fig. 1

and South Georgia and falls sharply to about 59° 30′ S in 70° W, rounding the Horn at below 60° S.

The sub-Antarctic Zone is limited to the south by the Antarctic convergence and to the north by the subtropical convergence; the latter is found in about 34° S in the meridian of Greenwich and falls gently to the east and to the west, until it reaches 44° S in the longitude of 30° E and 44° 30′ S in the longitude of 50° W, where it probably turns northwards again.

The subtropical Zone is less sharply defined; the convergence between it and the tropical zone originates probably in about 28° S in longitude 30° W, and extends obliquely through 30° of latitude to a position just north of the line at approximately 10° E. (Fig. 1.)

The zonal convergences are sufficiently well-marked to be logged with precision, and are due to the meeting of large areas of surface water of different temperature and salinity, the denser water sinking below the lighter. The geographical positions of the convergences and the consequent width of the zones tend to vary from season to season.

According to Dr T. J. Hart, it is reasonable to suppose that the striking changes of chemical and physical factors met within comparatively short distances of a convergence, together with the violence of the vertical mixing that ensues, are sufficient to keep the algal floras of the respective zones fairly separate, although a certain amount of overlapping is to be expected, particularly where the convergence is ill-defined.

The following table is compiled from data obtained by the 'Discovery II' during a passage up the middle of the South Atlantic along the 30th W meridian. The observations extend from 57° 36′ S to 14° 27¼′ N and show the great changes which are met with in passing through the four zones mentioned above.

In the table, data are given for two positions only, viz. at the surface of the water, and at a depth of 100 m.[1] These two levels have been selected because they define the limits of variation which operate on the diatom population.

The general indications are that the salinity, temperature and *p*H of the surface waters increase as we approach the equator, and the phosphate and nitrate concentrations, which are very high in polar waters, decrease rapidly in the subtropical Zone, phosphate being entirely absent from the surface waters N of latitude 26° 06½′ S.

This absence of phosphate is continued north of the Line for surface waters, but a considerable increase is noticed at the depth of 80–100 m. at a position 3° 20′ S of the equator, and on reaching a depth of 1000 m. the phosphate content is two and a half times more than that at 100 m. depth. A similar decrease is noticed for nitrate through the subtropical and tropical Zones, particularly at the surface of the water, although increase is again recorded at a depth of 100 m. The hydrological factors have been dealt with fully by Deacon (1933), and utilized by Hart (1934) in considering the distribution, abundance and constitution of the phytoplankton of the south-west Atlantic.

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[1] The full data will be found in *Discovery Reports*, IV, pp. 150–165 (1932).

*Hydrological data obtained during April–May 1931 on the 30th W meridian*

| St. No. | Position | Depth m. | Temp. °C. | Salinity ‰ | Density $\sigma_t$ | *p*H | $P_2O_5$ mg./m.$^3$ | $O_2$ cc. per l. | Nitrate + nitrite $N_2$ mg./m.$^3$ | Zone |
|---|---|---|---|---|---|---|---|---|---|---|
| 661 | 57° 36′ S, 29° 54½′ W | 0 | −0·81 | 33·33 | 26·81 | 7·97 | 105 | 7·43 | 510 | Antarctic |
| | | 100 | −0·99 | 34·20 | 27·53 | 7·91 | 130 | 6·20 | 530 | |
| 663 | 53° 34½′ S, 30° 25¾′ W | 0 | 0·51 | 33·60 | 26·97 | 7·98 | 98 | 7·39 | 490 | |
| | | 100 | −1·02 | 34·14 | 27·47 | 7·91 | 118 | 6·40 | 500 | |
| 666 | 49° 58¾′ S, 29° 52½′ W | 0 | 2·71 | 33·84 | 27·01 | 7·96 | 105 | 7·13 | 470 | |
| | | 100 | 1·86 | 33·90 | 27·12 | 7·94 | 107 | 7·06 | 480 | |
| 668 | 46° 42½′ S, 30° 22′ W | 0 | 8·59 | 34·20 | 26·57 | 8·08 | 79 | 6·20 | 210 | Sub-Antarctic |
| | | 100 | 5·86 | 34·29 | 27·03 | 7·96 | 94 | 5·92 | 250 | |
| 671 | 43° 08′ S, 30° 15¾′ W | 0 | 9·70 | 34·32 | 26·48 | 8·09 | 73 | 6·11 | — | |
| | | 100 | 7·86 | 34·37 | 26·82 | 8·01 | 87 | 6·00 | — | |
| 673 | 38° 10½′ S, 30° 10¼′ W | 0 | 17·39 | 35·16 | 25·55 | 8·17 | 9 | 5·18 | 60 | |
| | | 100 | 14·48 | 35·43 | 26·43 | 8·12 | 25 | 4·89 | 89 | |
| 675 | 34° 08′ S, 29° 50½′ W | 0 | 19·02 | 35·44 | 25·36 | 8·16 | 10 | 5·07 | 7 | Sub-tropical |
| | | 100 | 16·39 | 35·54 | 26·08 | 8·10 | 13 | 5·28 | 15 | |
| 677 | 31° 16¼′ S, 29° 56½′ W | 0 | 21·43 | 35·68 | 24·90 | 8·18 | 8 | 4·88 | 6 | |
| | | 100 | 17·12 | 35·55 | 25·91 | 8·14 | 10 | 5·31 | 6 | |
| 679 | 26° 06½′ S, 30° 06¼′ W | 0 | 25·24 | 36·56 | 24·47 | 8·25 | 0 | 4·60 | 6 | Tropical |
| | | 100 | 20·25 | 36·07 | 25·51 | 8·20 | 3 | 5·14 | 6 | |
| 681 | 21° 13′ S, 29° 55¼′ W | 0 | 27·20 | 37·34 | 24·43 | 8·30 | 0 | 4·40 | 2 | |
| | | 100 | 23·60 | 36·96 | 25·24 | 8·27 | 6 | 4·77 | 1 | |
| 684 | 15° 37′ S, 29° 53½′ W | 0 | 26·28 | 37·24 | 24·50 | 8·28 | 0 | 4·33 | 2 | |
| | | 100 | 24·46 | 37·08 | 25·07 | 8·26 | 2 | 4·68 | 0 | |
| 687 | 09° 47′ S, 29° 51′ W | 0 | 27·51 | 36·55 | 23·73 | 8·28 | 0 | 4·28 | 5 | |
| | | 100 | 24·32 | 36·94 | 25·01 | 8·25 | 3 | 4·77 | 1 | |
| 690 | 03° 17¾′ S, 29° 57¾′ W | 0 | 28·20 | 36·00 | 23·11 | 8·28 | 0 | 4·34 | 4 | |
| | | 100 | 17·61 | 35·91 | 26·06 | 8·04 | 54 | 2·98 | 43 | |
| 693 | 02° 59½′ N, 29° 59′ W | 0 | 27·91 | 35·60 | 22·87 | 8·29 | 0 | 4·37 | 2 | |
| | | 100 | 15·58 | 35·50 | 26·23 | 7·96 | 71 | 2·34 | 63 | |
| 696 | 08° 54¼′ N, 30° 02¾′ W | 0 | 26·08 | 36·09 | 23·85 | 8·30 | 0 | 4·47 | 2 | |
| | | 100 | 17·08 | 35·65 | 25·99 | 7·98 | 56 | 2·78 | 47 | |
| 699 | 14° 27¼′ N, 30° 02¼′ W | 0 | 23·90 | 36·34 | 24·68 | 8·26 | 0 | 4·63 | 3 | |
| | | 100 | 18·76 | 36·51 | 26·24 | 8·11 | 20 | 3·36 | 28 | |

## METHOD OF WORKING

Before a critical examination of the species could be made it was necessary to remove the larger crustaceans, fragments of animal and vegetable detritus, and to wash the diatoms free from salt. This was accomplished by passing the sample through a small No. 20 wire sieve, which removed the larger fragments, and then conveying the filtrate to a washer, illustrated in Fig. 2.

This apparatus, which was especially designed for the purpose, and has given excellent results, consisted of a glass cylinder *A*, $1\frac{1}{2}$ in. in diameter and 4 in. in length, fitted with a rubber cork through which passed two glass tubes of $\frac{3}{16}$ in. bore, one, *B*, passing just inside the cork and bent in the manner shown, the other, *C*, furnished with a pipette end and inserted through a rubber cork into a small glass tube *D* of $\frac{5}{8}$ in. bore, which had its lower end flanged. The flanged end was covered with a piece of bolting silk (200 mesh) and securely tied.

The filtrate was allowed to stand until the diatoms settled; the clear portion was then decanted, and the remainder agitated and gently poured into the small glass tube *D* until all the diatoms were resting on the silk. The glass tube *D* was then fitted on to the pipette end of the fine glass tube *C* and placed inside the cylinder. The apparatus was attached to the water supply by means of a piece of rubber tubing, and a slow stream allowed to pass through. Where the diatoms were very abundant, adequate portions of the filtrate were washed separately.

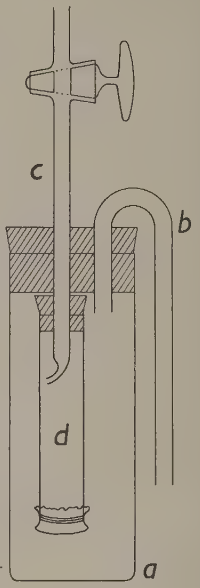

Fig. 2.

Washing was allowed to continue for two or three hours. The material was then removed from the silk, rinsed in distilled water and stored in glass tubes in alcohol.

The storage of phytoplankton samples in a solution of commercial formalin is to be avoided, as it has been noticed that after a time distinct changes in the hydrogen-ion concentration take place, particularly if the samples are placed in a position where they receive direct sunlight. Atkins (1922 *a*, *b*) has noted the effects of such changes upon certain algal cells, and has recommended the use of a permanently non-acid formalin for preserving calcareous specimens (1922 *c*). Tests made on some of the earlier samples (1927) dealt with in this work showed that the *p*H had been reduced to approximately 5·0, while, although formalin prepared with borax was used in later years, many of the 1931 samples registered a *p*H of 6·0. In view of this very considerable increase in acidity, the weakly siliceous nature of some of the Antarctic diatoms, and the prolonged period of storage, there is the possibility that some part of the original catch has not been preserved.

The usual method of cleaning diatoms, such as boiling with a mixture of pure mineral acids, cannot be adopted with plankton samples, as some of the typical genera, such as *Chaetoceros* and *Rhizosolenia*, are so weakly siliceous as not to survive so vigorous a treatment.

Further cleaning was effected after the diatoms had been placed upon the slide, and consisted in washing with acetone and clove oil and removing the oil with xylol and alcohol. All preliminary examinations were made in aqueous mounts.

In order to make specific identifications of diatoms it was necessary to mount them in a substance of a high refractive index. Owing to the extreme sensitiveness of plankton forms to almost any degree of heat great care had to be exercised in selecting and using the mounting medium.

For the major part of the work balsam was used, although the mixture suggested by Ghazzawi (1933) was often employed. This mixture consists of two parts of piperine and one part of antimony tribromide finely ground together. An adequate quantity of this mixture is added to a dry film of diatoms upon a glass slip. The slip is gently warmed until the powder melts, when the cover glass is placed into position and gently pressed down.

The mount sets perfectly hard in about 2 min. and is of a canary yellow colour.

Great care must be taken not to overheat the slide, or a darkening in colour is likely to occur and damage is done to the mount.

The mountant is quite permanent and requires no cement ring around the cover-glass, although such a ring enhances the appearance of the slide. It is easier and quicker to use than either natural or synthetic resins, and permits the use of oil immersion objectives immediately upon cooling. The refractive index is probably between 1·70 and 1·75.

This mountant gave excellent results with clean and strongly siliceous material, but owing to the degree of heat required to melt the crystalline mixture, it could not be used in the examination of fragile solenoid diatoms such as *Guinardia* or *Leptocylindrus* spp., as such treatment was accompanied almost invariably by the collapse of the frustules into an unidentifiable mass.

Much of the routine work was done, however, by examining the prepared material mounted dry upon the cover-glass. This method was always used in the examination of such genera as *Rhizosolenia*, *Corethron*, *Guinardia*, etc.

The film of diatoms, whether as a wet or a dry preparation, was examined with a modern microscope with a built-in mechanical stage and a centring substage focussing by rack-work; it was fitted with an achromatic dry condenser of N.A. 1·00, interchangeable with an oil-immersion condenser of N.A. 1·40. A battery of apochromatic objectives was used, comprising 16 mm. of N.A. 0·35, 8·0 mm. of N.A. 0·65, 4·0 mm. of N.A. 0·95, and 2·0 mm. of N.A. 1·40. The body of the microscope contained a 2-in. diameter draw-tube fitted with rack-work extension allowing adjustments to be made to accommodate variation in cover-glass thickness. A squared micrometer eyepiece was invariably used. The illumination was provided by a 60-watt pearl electric bulb for low-power routine work, and a tightly wound spiral filament lamp of 12 volts and 36 watts provided illumination for high-power work. The lamp-houses were of special design to prevent interference from extraneous light, and were fitted with iris diaphragms to control the volume of light used. The lamp was placed about 10 in. from the tail mirror of the microscope, and the interposition of light filters was sometimes found to enhance the image. In order that the lists of species should indicate the order of dominance, counts were made by means of the squared eyepiece, and all organisms were counted over as many optical fields as were thought necessary for the correct interpretation of the numbers obtained. The number of fields counted varied from 20 to 200 fields for each sample. This procedure will obviously afford only a very rough indication of the relative abundance of the different species, and cannot be expected to yield results comparable with those given by the far more laborious methods now employed for quantitative phytoplankton estimation.

## ACKNOWLEDGEMENTS

Throughout this work recourse has been made to the published accounts of the scientific results obtained by other Antarctic expeditions: in particular to Heiden and Kolbe (1928) on the marine diatoms obtained by the German South Polar Expedition,

1901–3, to H. van Heurck (1909) on the results of the voyage of the 'Belgica' from 1897 to 1899, to M. Petit (1908) and L. Mangin (1915) on the phytoplankton obtained during the French Antarctic Expeditions, and to G. Karsten (1905) on the Antarctic material collected by the 'Valdivia' on the German Deep-Sea Expedition, 1898–9. Use has been made of the Discovery Reports, particularly the papers of Dr T. J. Hart and Mr G. E. R. Deacon, also the Station Lists in vol. IV from which positions and hydrological data have been obtained.

My thanks are due to Dr Stanley Kemp, until lately Director of Research, for making available to me the log-books of the R.R.S. 'Discovery II' and the R.R.S. 'William Scoresby', from which data were obtained of the more recent commissions for which Station Lists have not yet been published.

My thanks are also due to Mr John Ramsbottom, O.B.E., Keeper of the Department of Botany of the British Museum, for allowing the major part of the work to be done in the Laboratories of the Department, and to Mr Geoffrey Tandy, Assistant Keeper of the Department of Botany, for the valued help received on the more intricate points of nomenclature, and the classical rendering of the descriptions of species described here for the first time.

## LIST OF STATIONS

A list of the stations from which phytoplankton samples were examined is given below. The station number, the geographical position and the date on which the sample was taken are given. These are followed by certain hydrological data, which are observations at the surface of the water. Temperature is expressed in degrees Centigrade, salinity as parts per thousand, phosphate content ($P_2O_5$) as milligrammes per cubic metre and the combined nitrite and nitrate content ($NO_3$) also as milligrammes per cubic metre. The net used at all stations was the 50-cm. net referred to on p. 155; it was hauled vertically and the depth of the haul is noted. Under each station a list of the species of diatom is given, the species being arranged in order of abundance (pp. 163–199).

### SYNOPSIS OF STATIONS

R.R.S. 'Discovery':

| | |
|---|---|
| 260–265 | Off South-West Africa |
| 275, 289–294 | Off west coast of Africa |

R.R.S. 'Discovery II':

| | |
|---|---|
| 300–305<br>334–340<br>475–483<br>501–513 | South Georgia |
| 365–368, 626 | South Sandwich Group |
| 378–388 | South Shetlands to Cape Horn |
| 424–450 | South Africa |
| 451–463 | Cape Town to west of Bouvet Island |
| 542–544<br>551–553 | Bransfield Strait, South Shetlands |
| 570–580 | Bellingshausen Sea |

| | |
|---|---|
| 615–619 | South Orkneys |
| 659–690 | South Georgia, South Sandwich Group to Cape Verde Islands |
| 719–723 | Brazil coast |
| 1356–1357 | South of South Africa |
| 1570–1589 | East coast of Africa |

R.R.S. 'William Scoresby':

| | |
|---|---|
| WS 100–107 | Falkland Islands to Port Desire, South America |
| WS 469 | South of Burdwood Bank |
| WS 474 | Off Elephant Island |
| WS 481 | Bransfield Strait |
| WS 540–552 | Weddell Sea |
| WS 569–716 | Peru Current, west coast of South America |

S.S. 'C. A. Larsen':

| | |
|---|---|
| RS 9, 17, 19, 20 | Ross Sea |

Marine Biological Station:

| | |
|---|---|
| MS 86–103 | East Cumberland Bay, South Georgia |

## R.R.S. 'DISCOVERY'

**St. 260.** 19. vii. 27. 33° 06′ 30″ S, 17° 45′ 15″ E. 100–0 m.
Temp. 13·97° C. Salinity 35·12 $^{\circ}/_{\circ\circ}$. *p*H 8·34.

*Planktoniella sol* (Wallich) Schütt
*Thalassiosira condensata* Cleve
*Rhizosolenia alata* Brightwell
*Coscinodiscus radiatus* Ehrenberg
*Coscinodiscus subtilis* Ehrenberg
*Fragilaria granulata* Karsten
*Nitzschia seriata* Cleve
*Coscinodiscus gigas* Ehrenberg
*Thalassiosira hyalina* (Grunow) Gran
*Licmophora Lyngbyei* (Kützing) Grunow ex Van Heurck
*Guinardia flaccida* (Castracane) Peragallo
*Actinocyclus octonarius* Ehrenberg
*Biddulphia mobiliensis* (Bailey) Grunow ex Van Heurck
*Actinoptychus senarius* Ehrenberg
*Ditylum Brightwellii* (West) Grunow ex Van Heurck
*Hemidiscus cuneiformis* Wallich
*Chaetoceros didymum* Ehrenberg
*Actinocyclus rotula* Brun
*Chaetoceros peruvianum* Brightwell
*Actinoptychus splendens* (Shadbolt) Ralfs ex Pritchard

**St. 261.** 19. vii. 27. 33° 06′ 30″ S, 17° 33′ 15″ E. 100–0 m.
Temp. 14·01° C. Salinity 35·13 $^{\circ}/_{\circ\circ}$. *p*H 8·34.

*Planktoniella sol* (Wallich) Schütt
*Coscinodiscus radiatus* Ehrenberg
*Coscinodiscus subtilis* Ehrenberg
*Fragilaria granulata* Karsten
*Stephanopyxis turris* (Greville) Ralfs ex Pritchard
*Actinoptychus senarius* Ehrenberg
*Asteromphalus Hookerii* Ehrenberg
*Rhizosolenia alata* Brightwell
*Coscinodiscus gigas* Ehrenberg
*Chaetoceros decipiens* Cleve
*Thalassiosira condensata* Cleve
*Biddulphia mobiliensis* (Bailey) Grunow ex Van Heurck

**St. 262.** 19. vii. 27. 33° 06′ 30″ S, 17° 21′ 30″ E. 100–0 m.
Temp. 15·33° C. Salinity 35·23 $^{\circ}/_{\circ\circ}$. *p*H 8·35.

*Planktoniella sol* (Wallich) Schütt
*Coscinodiscus radiatus* Ehrenberg
*Fragilaria granulata* Karsten
*Ditylum Brightwellii* (West) Grunow ex Van Heurck
*Rhizosolenia alata* Brightwell

*Stephanopyxis turris* (Greville) Ralfs ex Pritchard
*Chaetoceros atlanticum* Cleve
*Coscinodiscus gigas* Ehrenberg
*Thalassiosira condensata* Cleve
*Actinoptychus senarius* Ehrenberg
*Thalassiosira hyalina* (Grunow) Gran
*Chaetoceros didymum* Ehrenberg

St. **263**. 19. vii. 27. 33° 06′ S, 17° 08′ E. 100–0 m.
Temp. 15·45° C. Salinity 35·32 $^{\circ}/_{\circ\circ}$. *p*H 8·35.

*Planktoniella sol* (Wallich) Schütt
*Coscinodiscus lineatus* Ehrenberg
*Fragilaria granulata* Karsten
*Rhizosolenia simplex* Karsten
*Coscinodiscus radiatus* Ehrenberg
*Rhizosolenia alata* Brightwell
*Actinoptychus senarius* Ehrenberg
*Coscinodiscus Grani* Gough

St. **264**. 19/20. vii. 27. 33° 06′ S, 16° 55′ E. 100–0 m.
Temp. 15·24° C. Salinity 35·30 $^{\circ}/_{\circ\circ}$. *p*H 8·35.

*Planktoniella sol* (Wallich) Schütt
*Coscinodiscus lineatus* Ehrenberg
*Rhizosolenia simplex* Karsten
*Fragilaria granulata* Karsten
*Coscinodiscus Grani* Gough

St. **265**. 20. vii. 27. 33° 06′ 30″ S, 16° 32′ E. 100–0 m.
Temp. 15·31° C. Salinity 35·28 $^{\circ}/_{\circ\circ}$. *p*H 8·35.

*Planktoniella sol* (Wallich) Schütt

St. **275**. 4/5. viii. 27. 7° 51′ S, 12° 42′ E. 2 m.

*Rhizosolenia Shrubsolii* Cleve

St. **289**. 23/24. viii. 27. 3° 04′ 45″ N, 16° 52′ W. 100–0 m.
Temp. 25·30° C. Salinity 35·28 $^{\circ}/_{\circ\circ}$. *p*H 8·35.

*Planktoniella sol* (Wallich) Schütt
*Rhizosolenia hebetata* Bailey

St. **292**. 24. viii. 27. 4° 03′ 15″ N, 16° 51′ W. 100–0 m.
Temp. 25·93° C. Salinity 35·46 $^{\circ}/_{\circ\circ}$. *p*H 8·35.

*Rhizosolenia hebetata* Bailey

St. **293**. 24. viii. 27. 4° 18′ 15″ N, 16° 51′ W. 100–0 m.
Temp. 26·01° C. Salinity 35·46 $^{\circ}/_{\circ\circ}$. *p*H 8·36.

*Rhizosolenia hebetata* Bailey
*Chaetoceros coarctatum* Lauder
*Rhizosolenia Bergonii* H. Peragallo

St. **294**. 25. viii. 27. 4° 33′ 15″ N, 16° 52′ 45″ W. 100–0 m.
Temp. 26·30° C. Salinity 35·48 $^{\circ}/_{\circ\circ}$. *p*H 8·38.

*Rhizosolenia hebetata* Bailey
*Rhizosolenia alata* Brightwell
*Hemidiscus cuneiformis* Wallich

### R.R.S. ‘DISCOVERY II’

St. **300**. 20. i. 30. 52° 26½′ S, 37° 14′ W. 100–0 m.
Temp. 2·92° C. Salinity 33·84 $^{\circ}/_{\circ\circ}$. *p*H 8·07. $P_2O_5$ 83.

*Corethron criophilum* Castracane (spineless chains)
*Guinardia flaccida* (Castracane) Peragallo
*Eucampia balaustium* Castracane
*Rhizosolenia alata* Brightwell
*Rhizosolenia Shrubsolii* Cleve
*Fragilariopsis antarctica* (Castracane) Hustedt

St. **301**. 20/21. i. 30. 52° 36½′ S, 37° 14′ W. 100–0 m.
Temp. 2·85° C. Salinity 33·84 °/$_{\circ\circ}$. *p*H 8·08. $P_2O_5$ 79.
*Corethron criophilum* Castracane (spineless chains)
*Rhizosolenia alata* Brightwell
*Fragilariopsis antarctica* (Castracane) Hustedt
*Coscinodiscus kryophilus* Grunow
*Eucampia balaustium* Castracane
*Rhizosolenia hebetata* Bailey
*Rhizosolenia Shrubsolii* Cleve
*Chaetoceros criophilum* Castracane

St. **302**. 21. i. 30. 52° 46½′ S, 37° 12′ W. 100–0 m.
Temp. 2·81° C. Salinity 33·84 °/$_{\circ\circ}$. *p*H 8·08. $P_2O_5$ 69.
*Corethron criophilum* Castracane (spineless chains)
*Eucampia balaustium* Castracane
*Rhizosolenia alata* Brightwell
*Fragilariopsis antarctica* (Castracane) Hustedt
*Nitzschia seriata* Cleve
*Rhizosolenia Shrubsolii* Cleve
*Tropidoneis antarctica* Grunow
*Coscinodiscus kryophilus* Grunow
*Coscinodiscus stellaris* Roper

St. **303**. 21. i. 30. 53° 00′ S, 37° 11′ W. 100–0 m.
Temp. 2·95° C. Salinity 33·84 °/$_{\circ\circ}$. *p*H 8·09. $P_2O_5$ 73.
*Corethron criophilum* Castracane (spineless chains)
*Eucampia balaustium* Castracane
*Rhizosolenia hebetata* Bailey
*Rhizosolenia alata* Brightwell
*Nitzschia seriata* Cleve
*Rhizosolenia Shrubsolii* Cleve

St. **304**. 21. i. 30. 53° 06′ S, 37° 14′ W. 100–0 m.
Temp. 3·10° C. Salinity 33·82 °/$_{\circ\circ}$. *p*H 8·08. $P_2O_5$ 85.
*Corethron criophilum* Castracane (spineless chains)
*Eucampia balaustium* Castracane
*Rhizosolenia hebetata* Bailey
*Rhizosolenia alata* Brightwell
*Nitzschia seriata* Cleve
*Rhizosolenia Shrubsolii* Cleve
*Coscinodiscus stellaris* Roper
*Nitzschia closterium* (Ehrenberg) Wm. Smith

St. **305**. 21/22. i. 30. 53° 17′ S, 37° 10′ W. 100–0 m.
Temp. 3·30° C. Salinity 33·78 °/$_{\circ\circ}$. *p*H 8·08. $P_2O_5$ 84.
*Corethron criophilum* Castracane (spineless chains)
*Rhizosolenia alata* Brightwell
*Rhizosolenia hebetata* Bailey
*Melosira sphaerica* Karsten
*Coscinodiscus stellaris* Roper
*Eucampia balaustium* Castracane

St. **334**. 4. ii. 30. 55° 43′ S, 36° 51′ W. 100–0 m.
Temp. 3·01° C. Salinity 33·89 °/$_{\circ\circ}$. *p*H 8·11. $P_2O_5$ 77.
*Coscinodiscus curvatulus* Grunow
*Rhizosolenia rhombus* Karsten
*Rhizosolenia crassa* Karsten
*Corethron criophilum* Castracane
*Rhizosolenia styliformis* Brightwell

St. **335**. 4/5. ii. 30. 55° 33′ S, 36° 49½′ W. 100–0 m.
Temp. 2·80° C. Salinity 33·82 °/$_{\circ\circ}$. *p*H 8·13. $P_2O_5$ 69.
*Corethron criophilum* Castracane
*Coscinodiscus pyrenoidophorus* Karsten
*Rhizosolenia alata* Brightwell
*Rhizosolenia rhombus* Karsten
*Rhizosolenia crassa* Karsten
*Rhizosolenia styliformis* Brightwell

St. **336**. 5. ii. 30. 55° 21′ S, 36° 48½′ W. 100–0 m.
Temp. 2·80° C. Salinity 33·83 °/$_{\circ\circ}$. *p*H 8·12. $P_2O_5$ 83.
*Corethron criophilum* Castracane
*Coscinodiscus curvatulus* Grunow
*Coscinodiscus trigonus* Karsten
*Coscinodiscus pyrenoidophorus* Karsten
*Rhizosolenia styliformis* Brightwell
*Rhizosolenia alata* Brightwell
*Dactyliosolen antarcticus* Castracane

St. **337**. 5. ii. 30. 55° 09′ S, 36° 48′ W. 100–0 m.
Temp. 2·95° C. Salinity 33·88 $^\circ/_{00}$. *p*H 8·11. $P_2O_5$ 83.

*Corethron criophilum* Castracane
*Coscinodiscus trigonus* Karsten
*Coscinodiscus curvatulus* Grunow
*Rhizosolenia styliformis* Brightwell
*Coscinodiscus pyrenoidophorus* Karsten
*Rhizosolenia alata* Brightwell
*Dactyliosolen antarcticus* Castracane
*Chaetoceros neglectum* Karsten
*Rhizosolenia crassa* Karsten

St. **338**. 5. ii. 30. 55° 00½′ S, 36° 46′ W. 100–0 m.
Temp. 3·56° C. Salinity 33·86 $^\circ/_{00}$. *p*H 8·13. $P_2O_5$ 78.

*Corethron criophilum* Castracane
*Coscinodiscus trigonus* Karsten
*Rhizosolenia styliformis* Brightwell
*Coscinodiscus grandenucleatus* Karsten
*Coscinodiscus pyrenoidophorus* Karsten
*Chaetoceros neglectum* Karsten
*Rhizosolenia alata* Brightwell
*Rhizosolenia crassa* Karsten

St. **339**. 5. ii. 30. 54° 51½′ S, 36° 44½′ W. 100–0 m.
Temp. 4·08° C. Salinity 33·84 $^\circ/_{00}$. *p*H 8·12. $P_2O_5$ 66.

*Corethron criophilum* Castracane
*Coscinodiscus grandenucleatus* Karsten
*Rhizosolenia styliformis* Brightwell
*Rhizosolenia alata* Brightwell
*Asteromphalus Hookerii* Ehrenberg
*Rhizosolenia crassa* Karsten
*Rhizosolenia rhombus* Karsten

St. **340**. 5. ii. 30. 54° 36′ S, 36° 40½′ W. 100–0 m.
Temp. 4·30° C. Salinity 33·77 $^\circ/_{00}$. *p*H 8·14. $P_2O_5$ 71.

*Corethron criophilum* Castracane
*Coscinodiscus grandenucleatus* Karsten
*Coscinodiscus lineatus* Ehrenberg
*Rhizosolenia alata* Brightwell

St. **365**. 2. iii. 30. Between Visokoi and Candlemas Island, South Sandwich Islands; 56° 54′ S, 27° 00′ W. 100–0 m.
Temp. 0·49° C. Salinity 33·80 $^\circ/_{00}$. *p*H 8·09. $P_2O_5$ 89.

*Coscinodiscus sub-bulliens* Jörgensen
*Chaetoceros atlanticum* Cleve
*Dactyliosolen antarcticus* Castracane
*Chaetoceros dichaeta* Ehrenberg
*Corethron criophilum* Castracane (spineless chains)
*Rhizosolenia hebetata* Bailey
*Fragilariopsis antarctica* (Castracane) Hustedt
*Eucampia balaustium* Castracane
*Asteromphalus Hookerii* Ehrenberg
*Rhizosolenia alata* Brightwell
*Rhizosolenia simplex* Karsten

St. **368**. 8. iii. 30. One mile north of Twitcher Rock, Douglas Strait, Southern Thule, South Sandwich Islands. 100–0 m.
Temp. 0·11° C. Salinity 34·02 $^\circ/_{00}$. *p*H 8·05.

*Coscinodiscus sub-bulliens* Jörgensen
*Chaetoceros atlanticum* Cleve
*Chaetoceros criophilum* Castracane
*Rhizosolenia hebetata* Bailey
*Rhizosolenia alata* Brightwell
*Fragilariopsis antarctica* (Castracane) Hustedt
*Chaetoceros dichaeta* Ehrenberg
*Coscinodiscus lineatus* Ehrenberg
*Corethron criophilum* Castracane
*Actinocyclus bifrons* Karsten
*Asteromphalus parvulus* Karsten
*Dactyliosolen antarcticus* Castracane
*Rhizosolenia bidens* Karsten
*Biddulphia striata* Karsten
*Chaetoceros atlanticum* var. *neapolitana* (Schröder) Hustedt
*Asteromphalus Hookerii* Ehrenberg
*Eucampia balaustium* Castracane

St. **369**. 9. iii. 30. Between Southern Thule and Bristol Island, South Sandwich Islands, 59° 17¼′ S, 26° 57′ W. 100–0 m.

Temp. 0·28° C. Salinity 34·01 $^{0}/_{00}$. *p*H 8·06. $P_2O_5$ 90.

*Chaetoceros atlanticum* Cleve
*Coscinodiscus sub-bulliens* Jörgensen
*Chaetoceros criophilum* Castracane
*Coscinodiscus lineatus* Ehrenberg
*Rhizosolenia hebetata* Bailey
*Actinocyclus bifrons* Karsten
*Rhizosolenia alata* Brightwell
*Chaetoceros dichaeta* Ehrenberg
*Asteromphalus parvulus* Karsten
*Dactyliosolen antarcticus* Castracane
*Rhizosolenia bidens* Karsten

St. **378**. 13. iv. 30. 62° 21½′ S, 60° 36′ W. 100–0 m.

Temp. 0·39° C. Salinity 34·04 $^{0}/_{00}$. *p*H 8·06. $P_2O_5$ 115.

*Chaetoceros atlanticum* Cleve
*Chaetoceros dichaeta* Ehrenberg
*Chaetoceros sociale* Lauder
*Chaetoceros neglectum* Karsten
*Chaetoceros criophilum* Castracane
*Chaetoceros Castracanei* Karsten
*Corethron criophilum* Castracane
*Nitzschia seriata* Cleve
*Dactyliosolen antarcticus* Castracane
*Chaetoceros cruciatum* Karsten
*Fragilariopsis antarctica* (Castracane) Hustedt
*Eucampia balaustium* Castracane
*Rhizosolenia alata* Brightwell
*Rhizosolenia bidens* Karsten
*Asteromphalus parvulus* Karsten
*Actinocyclus Janus* Karsten
*Asteromphalus Hookerii* Ehrenberg
*Chaetoceros Chunii* Karsten
*Actinocyclus bifrons* Karsten
*Rhizosolenia simplex* Karsten

St. **379**. 13. iv. 30. 62° 14¼′ S, 60° 43¼′ W. 100–0 m.

Temp. 0·10° C. Salinity 34·04 $^{0}/_{00}$. *p*H 7·95. $P_2O_5$ 83.

*Chaetoceros atlanticum* Cleve
*Chaetoceros neglectum* Karsten
*Chaetoceros sociale* Lauder
*Chaetoceros dichaeta* Ehrenberg
*Chaetoceros criophilum* Castracane
*Corethron criophilum* Castracane
*Nitzschia seriata* Cleve
*Dactyliosolen antarcticus* Castracane
*Chaetoceros Castracanei* Karsten
*Rhizosolenia bidens* Karsten
*Asteromphalus parvulus* Karsten
*Coscinodiscus lineatus* Ehrenberg
*Chaetoceros cruciatum* Karsten
*Fragilariopsis antarctica* (Castracane) Hustedt
*Eucampia balaustium* Castracane
*Rhizosolenia alata* Brightwell
*Actinocyclus Janus* Karsten
*Coscinodiscus radiatus* Ehrenberg
*Chaetoceros Chunii* Karsten
*Actinocyclus bifrons* Karsten

St. **380**. 13. iv. 30. 62° 05½′ S, 60° 53½′ W. 100–0 m.

Temp. 0·30° C. Salinity 33·93 $^{0}/_{00}$. *p*H 7·97. $P_2O_5$ 98.

*Chaetoceros sociale* Lauder
*Chaetoceros dichaeta* Ehrenberg
*Chaetoceros atlanticum* Cleve
*Chaetoceros neglectum* Karsten
*Chaetoceros Castracanei* Karsten
*Chaetoceros criophilum* Castracane
*Corethron criophilum* Castracane
*Dactyliosolen antarcticus* Castracane
*Chaetoceros cruciatum* Karsten
*Nitzschia seriata* Cleve
*Rhizosolenia bidens* Karsten
*Fragilariopsis antarctica* (Castracane) Hustedt
*Coscinodiscus lineatus* Ehrenberg
*Eucampia balaustium* Castracane
*Asteromphalus parvulus* Karsten
*Rhizosolenia alata* Brightwell
*Chaetoceros Chunii* Karsten
*Actinocyclus Janus* Karsten
*Actinocyclus bifrons* Karsten

St. **381**. 13. iv. 30. 61° 56¾′ S, 61° 03¾′ W. 100–0 m.
Temp. 0·00° C. Salinity 33·89 $^{\circ}/_{\circ\circ}$. *p*H 8·00. $P_2O_5$ 100.

*Chaetoceros criophilum* Castracane
*Fragilariopsis antarctica* (Castracane) Hustedt
*Chaetoceros dichaeta* Ehrenberg
*Eucampia balaustium* Castracane
*Chaetoceros atlanticum* Cleve
*Dactyliosolen antarcticus* Castracane
*Rhizosolenia alata* Brightwell
*Rhizosolenia hebetata* Bailey
*Corethron criophilum* Castracane
*Thalassiosira subtilis* (Ostenfeld) Gran
*Leptocylindrus danicus* Cleve
*Coscinodiscus lineatus* Ehrenberg
*Asteromphalus Hookerii* Ehrenberg
*Actinocyclus bifrons* Karsten
*Asteromphalus parvulus* Karsten
*Rhizosolenia bidens* Karsten
*Nitzschia seriata* Cleve

St. **382**. 13/14. iv. 30. 61° 27½′ S, 61° 38½′ W. 100–0 m.
Temp. 0·32° C. Salinity 33·78 $^{\circ}/_{\circ\circ}$. *p*H 8·10. $P_2O_5$ 123.

*Chaetoceros atlanticum* Cleve
*Chaetoceros sociale* Lauder
*Chaetoceros neglectum* Karsten
*Chaetoceros dichaeta* Ehrenberg
*Chaetoceros Castracanei* Karsten
*Chaetoceros criophilum* Castracane
*Corethron criophilum* Castracane
*Fragilariopsis antarctica* (Castracane) Hustedt
*Nitzschia seriata* Cleve
*Dactyliosolen antarcticus* Castracane
*Chaetoceros cruciatum* Karsten
*Eucampia balaustium* Castracane
*Rhizosolenia alata* Brightwell
*Coscinodiscus lineatus* Ehrenberg
*Chaetoceros Chunii* Karsten
*Asteromphalus Hookerii* Ehrenberg
*Rhizosolenia hebetata* Bailey
*Asteromphalus parvulus* Karsten
*Actinocyclus Janus* Karsten
*Actinocyclus bifrons* Karsten
*Coscinodiscus oculoides* Karsten
*Rhizosolenia simplex* Karsten

St. **383**. 14. iv. 30. 60° 32′ S, 62° 42′ W. 100–0 m.
Temp. 0·45° C. Salinity 33·85 $^{\circ}/_{\circ\circ}$. *p*H 8·05. $P_2O_5$ 105.

*Chaetoceros atlanticum* Cleve
*Chaetoceros neglectum* Karsten
*Chaetoceros radiculum* Castracane
*Corethron criophilum* Castracane
*Dactyliosolen antarcticus* Castracane
*Chaetoceros dichaeta* Ehrenberg
*Nitzschia seriata* Cleve
*Coscinodiscus lineatus* Ehrenberg
*Rhizosolenia alata* Brightwell
*Rhizosolenia simplex* Karsten
*Chaetoceros compressum* Lauder
*Rhizosolenia bidens* Karsten
*Fragilariopsis antarctica* (Castracane) Hustedt
*Chaetoceros criophilum* Castracane
*Rhizosolenia hebetata* Bailey
*Coscinodiscus lentiginosus* Janisch
*Actinocyclus Janus* Karsten
*Asteromphalus parvulus* Karsten
*Chaetoceros Castracanei* Karsten
*Rhizosolenia Shrubsolii* Cleve

St. **384**. 14. iv. 30. 59° 36½′ S, 63° 43½′ W. 100–0 m.
Temp. 2·02° C. Salinity 33·86 $^{\circ}/_{\circ\circ}$. *p*H 8·07. $P_2O_5$ 115.

*Chaetoceros atlanticum* Cleve
*Chaetoceros dichaeta* Ehrenberg
*Rhizosolenia alata* Brightwell
*Nitzschia seriata* Cleve
*Corethron criophilum* Castracane (spineless chains)
*Rhizosolenia rhombus* Karsten
*Fragilariopsis antarctica* (Castracane) Hustedt
*Coscinodiscus lentiginosus* Janisch
*Actinocyclus intermittens* Karsten
*Asteromphalus parvulus* Karsten
*Dactyliosolen antarcticus* Castracane
*Rhizosolenia hebetata* Bailey
*Chuniella oceanica* (Karsten) Hendey
*Actinocyclus bifrons* Karsten

*Chaetoceros radiculum* Castracane
*Asteromphalus Hookerii* Ehrenberg
*Coscinodiscus lineatus* Ehrenberg
*Chaetoceros criophilum* Castracane

St. **385**. 15. iv. 30. 58° 41′ S, 64° 43½′ W. 100–0 m.
Temp. 4·89° C. Salinity 34·16 ‰. *p*H 8·10. $P_2O_5$ 91.

*Rhizosolenia styliformis* Brightwell
*Rhizosolenia alata* Brightwell
*Rhizosolenia polydactyla* Castracane
*Dactyliosolen antarcticus* Castracane
*Fragilariopsis antarctica* (Castracane) Hustedt
*Corethron criophilum* Castracane
*Nitzschia seriata* Cleve
*Chaetoceros dichaeta* Ehrenberg

St. **386**. 15. iv. 30. 57° 45½′ S, 65° 42′ W. 100–0 m.
Temp. 5·00° C. Salinity 34·15 ‰. *p*H 8·08. $P_2O_5$ 88.

*Rhizosolenia styliformis* Brightwell
*Rhizosolenia polydactyla* Castracane
*Rhizosolenia alata* Brightwell
*Chaetoceros atlanticum* Cleve
*Dactyliosolen antarcticus* Castracane
*Chaetoceros criophilum* Castracane
*Asteromphalus Hookerii* Ehrenberg
*Fragilariopsis antarctica* (Castracane) Hustedt
*Corethron criophilum* Castracane
*Coscinodiscus excentricus* Grunow
*Rhizosolenia Shrubsolii* Cleve
*Eucampia balaustium* Castracane
*Chaetoceros dichaeta* Ehrenberg

St. **387**. 16. iv. 30. 56° 50′ S, 66° 39′ W. 100–0 m.
Temp. 5·45° C. Salinity 34·12 ‰. *p*H 8·10. $P_2O_5$ 91.

*Rhizosolenia polydactyla* Castracane
*Rhizosolenia styliformis* Brightwell
*Rhizosolenia alata* Brightwell
*Dactyliosolen antarcticus* Castracane
*Chaetoceros atlanticum* Cleve
*Corethron criophilum* Castracane
*Rhizosolenia curvata* Zacharias

St. **388**. 16. iv. 30. 56° 19½′ S, 67° 09¾′ W. 100–0 m.
Temp. 7·59° C. Salinity 33·58 ‰. *p*H 8·11. $P_2O_5$ 74.

*Rhizosolenia styliformis* Brightwell
*Rhizosolenia polydactyla* Castracane
*Rhizosolenia alata* Brightwell
*Fragilariopsis antarctica* (Castracane) Hustedt
*Dactyliosolen antarcticus* Castracane
*Chaetoceros atlanticum* Cleve
*Corethron criophilum* Castracane
*Rhizosolenia curvata* Zacharias
*Nitzschia seriata* Cleve
*Coscinodiscus lineatus* Ehrenberg
*Chaetoceros criophilum* Castracane

St. **424**. 4. ix. 30. 34° 15¼′ S, 25° 58½′ E. 100–0 m.
Temp. 17·11° C. Salinity 35·34 ‰. *p*H 8·33. $P_2O_5$ 49.

*Planktoniella sol* (Wallich) Schütt
*Thalassiothrix longissima* Cleve et Grunow
*Coscinodiscus radiatus* Ehrenberg
*Asterolampra marylandica* Ehrenberg

St. **425**. 4. ix. 30. 34° 52′ S, 26° 36′ E. 100–0 m.
Temp. 21·09° C. Salinity 35·41 ‰. *p*H 8·34. $P_2O_5$ 26.

*Chaetoceros messanense* Castracane
*Chaetoceros aequatoriale* Cleve
*Lauderia punctata* Karsten
*Guinardia flaccida* (Castracane) Peragallo
*Planktoniella sol* (Wallich) Schütt
*Stephanopyxis Palmeriana* (Greville) Grunow
*Thalassionema nitzschioides* Hustedt
*Bacteriastrum elongatum* Cleve
*Chaetoceros didymum* Ehrenberg
*Rhizosolenia calcar-avis* Schultze
*Rhizosolenia fragilissima* Bergon
*Bacteriastrum varians* Lauder
*Chaetoceros dichaeta* Ehrenberg
*Chaetoceros filiferum* Karsten

*Rhizosolenia alata* Brightwell
*Ditylum sol* Grunow
*Rhizosolenia simplex* Karsten
*Schroderella delicatula* (Peragallo) Pavillard
*Chaetoceros criophilum* Castracane
*Bellerochea indica* Karsten
*Chaetoceros curvatum* Castracane
*Hemiaulus Hauckii* Grunow ex Van Heurck
*Asterolampra marylandica* Ehrenberg
*Climacodium Frauenfeldianum* Grunow
*Rhizosolenia robusta* Norman
*Eucampia cornuta* (Cleve) Grunow
*Rhizosolenia bidens* Karsten
*Bacteriastrum hyalinum* var. *princeps* (Castracane) Ikari
*Chaetoceros peruvianum* Brightwell
*Chaetoceros seychellarum* Karsten
*Chaetoceros buceros* Karsten
*Chaetoceros breve* Schütt
*Coscinodiscus radiatus* Ehrenberg
*Dactyliosolen mediterraneus* H. Peragallo
*Bacteriastrum delicatulum* Cleve
*Asteromphalus heptactis* (Brébisson) Ralfs
*Chaetoceros sumatranum* Karsten
*Coscinodiscus oculus-Iridis* Ehrenberg
*Chaetoceros Ralfsi* Cleve

St. **427**. 7. ix. 30. 36° 37½′ S, 28° 52′ E. 100–0 m. (2 hauls).
Temp. 18·01° C. Salinity 35·48 $^{\circ}/_{\circ\circ}$. *p*H 8·36. $P_2O_5$ 31.

*Chaetoceros dichaeta* Ehrenberg
*Bacteriastrum elongatum* Cleve
*Chaetoceros decipiens* Cleve
*Eucampia balaustium* Castracane
*Bacteriastrum varians* Lauder
*Rhizosolenia alata* Brightwell
*Chaetoceros didymum* Ehrenberg
*Rhizosolenia simplex* Karsten
*Schroderella delicatula* (Peragallo) Pavillard
*Rhizosolenia calcar-avis* Schultze
*Lauderia punctata* Karsten
*Thalassiothrix longissima* Cleve et Grunow
*Chaetoceros criophilum* Castracane
*Chaetoceros messanense* Castracane
*Chaetoceros compressum* Lauder
*Stephanopyxis Palmeriana* (Greville) Grunow
*Thalassionema nitzschiodes* Hustedt
*Rhizosolenia styliformis* Brightwell
*Bacteriastrum delicatulum* Cleve
*Planktoniella sol* (Wallich) Schütt
*Rhizosolenia fragilissima* Bergon
*Chaetoceros aequatoriale* Cleve
*Chaetoceros peruvianum* Brightwell
*Chaetoceros atlanticum* var. *neapolitana* (Schröder) Hustedt
*Hemidiscus cuneiformis* Wallich
*Chaetoceros curvatum* Castracane
*Chaetoceros buceros* Karsten
*Chaetoceros peruvianum* Brightwell
*Bacteriastrum hyalinum* var. *princeps* (Castracane) Ikari

St. **428**. 7. ix. 30. 37° 14′ S, 29° 35′ E. 100–0 m.
Temp. 18·36° C. Salinity 35·50 $^{\circ}/_{\circ\circ}$. *p*H 8·34.

*Chaetoceros messanense* Castracane
*Planktoniella sol* (Wallich) Schütt
*Rhizosolenia alata* Brightwell
*Rhizosolenia calcar-avis* Schultze
*Bacteriastrum elongatum* Cleve
*Lauderia punctata* Karsten
*Schroderella delicatula* (Peragallo) Pavillard
*Chaetoceros dichaeta* Ehrenberg
*Chaetoceros decipiens* Cleve
*Stephanopyxis Palmeriana* (Greville) Grunow
*Rhizosolenia robusta* Norman
*Rhizosolenia simplex* Karsten
*Chaetoceros didymum* Ehrenberg
*Rhizosolenia fragilissima* Bergon
*Thalassionema nitzschioides* Hustedt
*Bacteriastrum varians* Lauder
*Bacteriastrum hyalinum* var. *princeps* (Castracane) Ikari
*Climacodium Frauenfeldianum* Grunow
*Eucampia cornuta* (Cleve) Grunow
*Thalassiothrix longissima* Cleve et Grunow
*Chaetoceros atlanticum* var. *neapolitana* (Schröder) Hustedt
*Chaetoceros atlanticum* Cleve
*Chaetoceros breve* Schütt
*Chaetoceros compressum* Lauder
*Leptocylindrus danicus* Cleve
*Pleurosigma directum* Grunow
*Bellerochea indica* Karsten
*Chaetoceros peruvianum* Brightwell
*Chaetoceros buceros* Karsten

St. **431**. 9. ix. 30. 41° 58′ S, 35° 56¾′ E. 100–0 m.
Temp. 11·61° C. Salinity 34·84 $^{\circ}/_{\circ\circ}$. *p*H 8·28. $P_2O_5$ 56.

*Rhizosolenia alata* Brightwell
*Rhizosolenia styliformis* Brightwell
*Planktoniella sol* (Wallich) Schütt
*Thalassionema nitzschioides* Hustedt
*Chaetoceros capense* Karsten
*Fragilaria granulata* Karsten

St. **432**. 10. ix. 30. 40° 48′ S, 34° 36½ E. 100–0 m.
Temp. 13·19° C. Salinity 35·05 $^{\circ}/_{\circ\circ}$. *p*H 8·29. $P_2O_5$ 35.

*Planktoniella sol* (Wallich) Schütt
*Rhizosolenia alata* Brightwell
*Rhizosolenia styliformis* Brightwell
*Chaetoceros pseudocrinitum* Ostenfeld
*Bacteriastrum elongatum* Cleve
*Chaetoceros decipiens* Cleve
*Chaetoceros peruvianum* Brightwell
*Rhizosolenia simplex* Karsten
*Chaetoceros criophilum* Castracane
*Synedra pelagica* Hendey
*Fragilaria granulata* Karsten

St. **433**. 10/11. ix. 30. 39° 37½′ S, 33° 06′ E. 100–0 m.
Temp. 17·21° C. Salinity 35·49 $^{\circ}/_{\circ\circ}$. *p*H 8·34. $P_2O_5$ 33.

*Chaetoceros breve* Schütt
*Planktoniella sol* (Wallich) Schütt
*Rhizosolenia alata* Brightwell
*Chaetoceros decipiens* Cleve
*Chaetoceros messanense* Castracane
*Thalassiosira antarctica* Karsten
*Rhizosolenia styliformis* Brightwell
*Lauderia punctata* Karsten
*Stephanopyxis Palmeriana* (Greville) Grunow
*Chaetoceros didymum* Ehrenberg
*Rhizosolenia curvata* Zacharias
*Chaetoceros dichaeta* Ehrenberg
*Guinardia flaccida* (Castracane) Peragallo
*Thalassionema nitzschioides* Hustedt
*Rhizosolenia fragilissima* Bergon
*Chaetoceros seychellarum* Karsten
*Corethron criophilum* Castracane
*Rhizosolenia simplex* Karsten
*Rhizosolenia Stolterfothii* H. Peragallo
*Bacteriastrum varians* Lauder
*Eucampia balaustium* Castracane
*Chaetoceros peruvianum* Brightwell
*Rhizosolenia robusta* Norman
*Dactyliosolen mediterraneus* H. Peragallo
*Chaetoceros aequatoriale* Cleve
*Rhizosolenia imbricata* Brightwell

St. **434**. 11. ix. 30. 38° 27½′ S, 31° 28′ E. 100–0 m.
Temp. 14·86° C. Salinity 35·23 $^{\circ}/_{\circ\circ}$. *p*H 8·28. $P_2O_5$ 36.

*Bacteriastrum elongatum* Cleve
*Chaetoceros messanense* Castracane
*Fragilaria granulata* Karsten
*Coscinodiscus radiatus* Ehrenberg
*Rhizosolenia alata* Brightwell
*Thalassiothrix acuta* Karsten
*Nitzschia seriata* Cleve
*Planktoniella sol* (Wallich) Schütt
*Chaetoceros didymum* Ehrenberg
*Schroderella Schroderi* (Bergon) Pavillard
*Chaetoceros capense* Karsten
*Ditylum sol* Grunow
*Thalassiosira subtilis* (Ostenfeld) Gran
*Schroderella delicatula* (Peragallo) Pavillard
*Lauderia punctata* Karsten
*Chaetoceros decipiens* Cleve
*Guinardia flaccida* (Castracane) Peragallo
*Coscinodiscus excentricus* Ehrenberg
*Stephanopyxis Palmeriana* (Greville) Grunow
*Chaetoceros peruvianum* Brightwell
*Thalassionema nitzschioides* Hustedt
*Synedra stricta* Karsten
*Cerataulina Bergonii* H. Peragallo
*Rhizosolenia Stolterfothii* H. Peragallo
*Chaetoceros neglectum* Karsten
*Chaetoceros compressum* Lauder
*Hemidiscus cuneiformis* Wallich
*Biddulphia mobiliensis* (Bailey) Grunow ex Van Heurck
*Coscinodiscus nodulifer* Janisch
*Rhizosolenia Castracani* H. Peragallo
*Climacodium biconcavum* H. Peragallo.
*Pseudo-triceratium cinnamomeum* (Greville) Grunow

St. **435**. 12/13. ix. 30. 35° 47′ S, 27° 49′ E. 100–0 m.
Temp. 19·11° C. Salinity 35·48 °/$_{00}$. *p*H 8·33. $P_2O_5$ 35.

*Chaetoceros messanense* Castracane
*Thalassiothrix acuta* Karsten
*Planktoniella sol* (Wallich) Schütt
*Chaetoceros didymum* Ehrenberg
*Bacteriastrum elongatum* Cleve
*Schroderella delicatula* (Peragallo) Pavillard
*Thalassiosira subtilis* (Ostenfeld) Gran
*Bacteriastrum criophilum* Karsten
*Chaetoceros peruvianum* Brightwell
*Bacteriastrum hyalinum* var. *princeps* (Castracane) Ikari
*Guinardia flaccida* (Castracane) Peragallo
*Chaetoceros decipiens* Cleve
*Rhizosolenia simplex* Karsten
*Synedra stricta* Karsten
*Thalassionema nitzschioides* Hustedt
*Chaetoceros capense* Karsten
*Chaetoceros neglectum* Karsten
*Rhizosolenia alata* Brightwell
*Chaetoceros atlanticum*, var. *neapolitana* (Schröder) Hustedt
*Chaetoceros aequatoriale* Cleve
*Rhizosolenia Stolterfothii* H. Peragallo
*Rhizosolenia robusta* Norman ex Pritchard
*Stephanopyxis turris* (Greville) Ralfs ex Pritchard

St. **436**. 20. ix. 30. 29° 55¾′ S, 31° 26¾′ E. 100–0 m.
Temp. 20·87° C. Salinity 35·41 °/$_{00}$. *p*H 8·33. $P_2O_5$ 21.

*Thalassiothrix acuta* Karsten
*Synedra stricta* Karsten
*Rhizosolenia simplex* Karsten
*Rhizosolenia alata* Brightwell
*Ditylum Brightwellii* (West) Grunow ex Van Heurck
*Chaetoceros neglectum* Karsten
*Planktoniella sol* (Wallich) Schütt
*Thalassiosira subtilis* (Ostenfeld) Gran
*Eucampia balaustium* Castracane
*Chaetoceros capense* Karsten
*Thalassiothrix longissima* Cleve et Grunow
*Bacteriastrum elongatum* Cleve
*Chaetoceros messanense* Castracane
*Schroderella Schroderi* (Bergon) Pavillard
*Eucampia cornuta* (Cleve) Grunow
*Coscinodiscus radiatus* Ehrenberg
*Corethron criophilum* Castracane
*Climacodium biconcavum* Cleve
*Triceratium favus* Ehrenberg
*Lauderia punctata* Karsten

St. **437**. 20. ix. 30. 29° 59′ S, 31° 47′ E. 100–0 m.
Temp. 20·08° C. Salinity 35·45 °/$_{00}$. *p*H 8·32. $P_2O_5$ 16.

*Rhizosolenia alata* Brightwell
*Rhizosolenia calcar-avis* Schultze
*Thalassiothrix acuta* Karsten
*Schroderella delicatula* (Peragallo) Pavillard
*Chaetoceros messanense* Castracane
*Chaetoceros capense* Karsten
*Chaetoceros decipiens* Cleve
*Planktoniella sol* (Wallich) Schütt
*Thalassiosira subtilis* (Ostenfeld) Gran
*Chaetoceros didymum* Ehrenberg
*Bacteriastrum elongatum* Cleve
*Stephanopyxis turris* (Greville) Ralfs ex Pritchard
*Chaetoceros peruvianum* Brightwell
*Chaetoceros neglectum* Karsten
*Pleurosigma directum* Grunow
*Bacteriastrum criophilum* Karsten

St. **438**. 20/21. ix. 30. 30° 05½′ S, 32° 05½′ E. 100–0 m.
Temp. 20·03° C. Salinity 35·42 °/$_{00}$. *p*H 8·32. $P_2O_5$ 16.

*Bacteriastrum elongatum* Cleve
*Rhizosolenia alata* Brightwell
*Rhizosolenia styliformis* Brightwell
*Chaetoceros peruvianum* Brightwell
*Bacteriastrum hyalinum* var. *princeps* (Castracane) Ikari
*Synedra stricta* Karsten
*Chaetoceros messanense* Castracane
*Planktoniella sol* (Wallich) Schütt
*Thalassiothrix acuta* Karsten
*Thalassiosira subtilis* (Ostenfeld) Gran
*Chaetoceros buceros* Karsten
*Chaetoceros capense* Karsten
*Chaetoceros decipiens* Cleve

*Schroderella delicatula* (Peragallo) Pavillard
*Chaetoceros didymum* Ehrenberg
*Chaetoceros neglectum* Karsten
*Coscinodiscus radiatus* Ehrenberg
*Bacteriastrum criophilum* Karsten
*Pleurosigma directum-secundum* Karsten
*Rhizosolenia Castracani* H. Peragallo
*Rhizosolenia simplex* Karsten

St. **439**. 21. ix. 30. 30° 12′ S, 32° 24′ E. 100–0 m.
Temp. 19·62° C. Salinity 35·47 $^{\circ}/_{\circ\circ}$. *p*H 8·33. $P_2O_5$ 16.

*Chaetoceros messanense* Castracane
*Chaetoceros decipiens* Cleve
*Chaetoceros atlanticum* var. *neapolitana* (Schröder) Hustedt
*Chaetoceros peruvianum* Brightwell
*Rhizosolenia alata* Brightwell
*Rhizosolenia simplex* Karsten
*Chaetoceros neglectum* Karsten
*Thalassiothrix acuta* Karsten
*Chaetoceros capense* Karsten
*Bacteriastrum elongatum* Cleve
*Planktoniella sol* (Wallich) Schütt
*Rhizosolenia calcar-avis* Schultze
*Thalassiosira subtilis* (Ostenfeld) Gran
*Bacteriastrum criophilum* Karsten
*Chaetoceros breve* Schütt
*Coscinodiscus radiatus* Ehrenberg
*Eucampia cornuta* (Cleve) Grunow
*Thalassiothrix longissima* Cleve et Grunow
*Synedra stricta* Karsten
*Bacteriastrum hyalinum* var. *princeps* (Castracane) Ikari
*Schroderella delicatula* (Peragallo) Pavillard
*Corethron criophilum* Castracane
*Rhizosolenia Stolterfothii* H. Peragallo

St. **440**. 21. ix. 30. 30° 19½′ S, 32° 48′ E. 100–0 m.
Temp. 19·64° C. Salinity 35·45 $^{\circ}/_{\circ\circ}$. *p*H 8·31. $P_2O_5$ 17.

*Planktoniella sol* (Wallich) Schütt
*Rhizosolenia alata* Brightwell
*Rhizosolenia simplex* Karsten
*Chaetoceros convolutum* Castracane
*Chaetoceros messanense* Castracane
*Thalassiothrix longissima* Cleve et Grunow
*Bacteriastrum elongatum* Cleve
*Chaetoceros peruvianum* Brightwell
*Thalassionema nitzschioides* Hustedt
*Ditylum sol* Grunow
*Eucampia cornuta* (Cleve) Grunow
*Hemiaulus Hauckii* Grunow ex Van Heurck
*Eucampia balaustium* Castracane
*Gossleriella tropica* Schütt
*Chaetoceros curvatum* Castracane
*Chaetoceros didymum* Ehrenberg
*Planktoniella formosa* (Karsten) Karsten
*Coscinodiscus lineatus* Ehrenberg
*Climacodium Frauenfeldianum* Grunow
*Rhizosolenia crassa* Karsten
*Coscinodiscus intermittens* Karsten
*Coscinodiscus beta* Karsten
*Chaetoceros aequatoriale* Cleve
*Chaetoceros seychellarum* Karsten
*Hemidiscus cuneiformis* Wallich
*Amphiprora Kjellmani* Cleve
*Tropidoneis proteus* Karsten
*Rhizosolenia robusta* Norman

St. **449**. 11/12. x. 30. 42° 30½′ S, 15° 14¼′ E. 100–0 m.
Temp. 9·45° C. Salinity 34·39 $^{\circ}/_{\circ\circ}$. *p*H 8·19. $P_2O_5$ 50

*Rhizosolenia hebetata* Bailey
*Planktoniella sol* (Wallich) Schütt

St. **450**. 12/13. x. 30. 44° 57′ S, 12° 55½′ E. 100–0 m.
Temp. 11·33° C. Salinity 34·96 $^{\circ}/_{\circ\circ}$. *p*H 8·18. $P_2O_5$ 59.

*Planktoniella sol* (Wallich) Schütt
*Rhizosolenia hebetata* Bailey
*Rhizosolenia alata* Brightwell
*Thalassiothrix longissima* Cleve et Grunow
*Coscinodiscus radiatus* Ehrenberg
*Coscinodiscus lineatus* Ehrenberg
*Corethron criophilum* Castracane
*Chaetoceros peruvianum* Brightwell

St. **451**. 13/14. x. 30. 47° $19\frac{3}{4}'$ S, 11° 05′ E. 100–0 m.
Temp. 5·15° C. Salinity 33·86 $^\circ/_{oo}$. *p*H 8·13. $P_2O_5$ 91.

*Dactyliosolen antarcticus* Castracane
*Planktoniella sol* (Wallich) Schütt
*Fragilariopsis antarctica* (Castracane) Hustedt
*Rhizosolenia hebetata* Bailey
*Coscinodiscus excentricus* Ehrenberg
*Asteromphalus heptactis* (Brébisson) Ralfs
*Coscinodiscus variolatus* Castracane
*Corethron criophilum* Castracane
*Hemidiscus cuneiformis* Wallich
*Chaetoceros atlanticum* Cleve
*Chaetoceros pelagicum* Cleve

St. **452**. 14. x. 30. 49° 50′ S, 8° $32\frac{1}{2}'$ E. 100–0 m.
Temp. 1·94° C. Salinity 33·79 $^\circ/_{oo}$. *p*H 8·09. $P_2O_5$ 79.

*Fragilariopsis antarctica* (Castracane) Hustedt
*Planktoniella sol* (Wallich) Schütt
*Corethron criophilum* Castracane
*Chaetoceros dichaeta* Ehrenberg
*Hemidiscus cuneiformis* Wallich
*Tropidoneis antarctica* Grunow
*Coscinodiscus oculoides* Karsten

St. **453**. 16/17. x. 30. 54° 06′ S, 4° 00′ E. 100–0 m.
Temp. −1·60° C. Salinity 34·07 $^\circ/_{oo}$. *p*H 7·98. $P_2O_5$ 95.

*Corethron criophilum* Castracane
*Fragilariopsis antarctica* (Castracane) Hustedt
*Dactyliosolen antarcticus* Castracane
*Coscinodiscus lentiginosus* Janisch
*Tropidoneis antarctica* Grunow
*Asteromphalus heptactis* (Brébisson) Ralfs
*Chaetoceros radiculum* Castracane
*Chaetoceros peruvianum* Brightwell
*Chaetoceros criophilum* Castracane
*Coscinodiscus oppositus* Karsten
*Actinocyclus corona* Karsten
*Chaetoceros dichaeta* Ehrenberg
*Coscinodiscus oculoides* Karsten

St. **460**. 20/21. x. 30. 56° 46′ S, 0° $41\frac{3}{4}'$ W. 100–0 m.
Temp. −1·29° C. Salinity 34·08 $^\circ/_{oo}$. *p*H 7·95. $P_2O_5$ 104.

*Fragilariopsis antarctica* (Castracane) Hustedt
*Chaetoceros cruciatum* Karsten
*Rhizosolenia hebetata* Bailey
*Corethron criophilum* Castracane
*Chaetoceros dichaeta* Ehrenberg
*Rhizosolenia Shrubsolii* Cleve
*Chaetoceros criophilum* Castracane
*Chaetoceros atlanticum* Cleve
*Melosira sphaerica* Karsten
*Rhizosolenia alata* Brightwell
*Thalassiothrix longissima* Cleve et Grunow
*Coscinodiscus radiatus* Ehrenberg
*Dactyliosolen antarcticus* Castracane
*Coscinodiscus hexagonalis* Karsten

St. **461**. 21/22. x. 30. Position 56° 44′ S, 2° $23\frac{3}{4}'$ W. 100–0 m. Seven stations in close proximity, 461 A–461 G, are here included.
Temp. −1·72° C. Salinity 34·15 $^\circ/_{oo}$. $P_2O_5$ 104.

*Corethron criophilum* Castracane
*Rhizosolenia alata* Brightwell
*Fragilariopsis antarctica* (Castracane) Hustedt
*Chaetoceros criophilum* Castracane
*Thalassiosira antarctica* Comber
*Dactyliosolen antarcticus* Castracane
*Coscinodiscus hexagonalis* Karsten
*Chaetoceros dichaeta* Ehrenberg
*Chaetoceros cruciatum* Karsten
*Rhizosolenia rhombus* Karsten
*Actinocyclus intermittens* Karsten
*Asteromphalus Hookerii* Ehrenberg
*Eucampia balaustium* Castracane
*Rhizosolenia crassa* Schimper ex Karsten
*Rhizosolenia styliformis* Brightwell
*Charcotia bifrons* (Castracane) Peragallo
*Schimperiella valdiviae* Karsten
*Biddulphia striata* Karsten
*Rhizosolenia truncata* Karsten

St. **463**. 24. x. 30. 55° 42′ S, 10° 54′ W. 100–0 m.
Temp. −1·80° C. Salinity 33·89 °/$_{oo}$. *p*H 7·97.

*Corethron criophilum* Castracane
*Fragilariopsis antarctica* (Castracane) Hustedt
*Chaetoceros criophilum* Castracane
*Rhizosolenia alata* Brightwell
*Coscinodiscus variolatus* Castracane
*Tropidoneis antarctica* Grunow
*Coscinodiscus bouvet* Karsten
*Dactyliosolen antarcticus* Castracane
*Chaetoceros dichaeta* Ehrenberg
*Charcotia bifrons* (Castracane) Peragallo
*Eucampia balaustium* Castracane
*Nitzschia seriata* Cleve

St. **475**. 12. xi. 30. 53° $30\frac{1}{4}'$ S, 42° $44\frac{1}{2}'$ W. 100–0 m.
Temp. 0·00° C. Salinity 34·03 °/$_{oo}$. *p*H 7·98. $P_2O_5$ 109.

*Corethron criophilum* Castracane
*Chaetoceros criophilum* Castracane
*Chaetoceros neglectum* Karsten
*Coscinodiscus subtilis* Ehrenberg
*Biddulphia striata* Karsten
*Rhizosolenia styliformis* Brightwell
*Coscinodiscus lentiginosus* Janisch
*Rhizosolenia alata* Brightwell
*Fragilaria striatula* Lyngbye
*Asteromphalus Roperianus* Ralfs ex Pritchard
*Rhizosolenia bidens* Karsten
*Schimperiella antarctica* Karsten
*Chaetoceros atlanticum* Cleve
*Fragilariopsis antarctica* (Castracane) Hustedt
*Coscinodiscus inflatus* Karsten
*Actinocyclus bifrons* Karsten
*Coscinodiscus decrescens* Grunow
*Dactyliosolen antarcticus* Castracane
*Eucampia balaustium* Castracane
*Chuniella oceanica* (Karsten) Hendey
*Coscinodiscus Chunii* Karsten
*Asteromphalus Hookerii* Ehrenberg
*Pleurosigma directum* Karsten
*Coscinodiscus bouvet* Karsten
*Coscinodiscus radiatus* Ehrenberg
*Actinocyclus Janus* Karsten
*Nitzschia seriata* Cleve
*Charcotia bifrons* (Castracane) Peragallo
*Nitzschia pelagica* Karsten

St. **477**. 13. xi. 30. 53° $35\frac{1}{2}'$ S, 41° $25\frac{3}{4}'$ W. 100–0 m.
Temp. 0·00° C. Salinity 34·02 °/$_{oo}$. *p*H 7·98. $P_2O_5$ 104.

*Corethron criophilum* Castracane
*Biddulphia striata* Karsten
*Chaetoceros criophilum* Castracane
*Fragilariopsis antarctica* (Castracane) Hustedt
*Dactyliosolen antarcticus* Castracane
*Actinocyclus Janus* Karsten
*Coscinodiscus lentiginosus* Janisch
*Asteromphalus Hookerii* Ehrenberg
*Coscinodiscus Chunii* Karsten
*Rhizosolenia styliformis* Brightwell
*Coscinodiscus subtilis* Ehrenberg
*Chaetoceros atlanticum* Cleve
*Coscinodiscus decrescens* Grunow
*Coscinodiscus curvatulus* Grunow
*Chaetoceros cruciatum* Karsten
*Rhizosolenia alata* Brightwell
*Actinocyclus bifrons* Karsten
*Actinocyclus intermittens* Karsten
*Coscinodiscus variolatus* Castracane
*Chaetoceros neglectum* Karsten
*Actinocyclus umbonatus* Castracane
*Nitzschia pelagica* Karsten

St. **478**. 13. xi. 30. 53° $38\frac{1}{2}'$ S, 40° 53′ W. 100–0 m.
Temp. 0·20° C. Salinity 33·93 °/$_{oo}$. *p*H 8·01. $P_2O_5$ 101.

*Corethron criophilum* Castracane
*Fragilariopsis antarctica* (Castracane) Hustedt
*Chaetoceros criophilum* Castracane
*Rhizosolenia styliformis* Brightwell
*Actinocyclus umbonatus* Castracane
*Actinocyclus bifrons* Karsten
*Asteromphalus Hookerii* Ehrenberg
*Biddulphia striata* Karsten
*Actinocyclus Janus* Karsten
*Dactyliosolen antarcticus* Castracane
*Nitzschia seriata* Cleve
*Asteromphalus Roperianus* Ralfs ex Pritchard

*Chaetoceros cruciatum* Karsten
*Rhizosolenia alata* Brightwell
*Chaetoceros atlanticum* Cleve
*Rhizosolenia simplex* Karsten
*Coscinodiscus subtilis* Ehrenberg
*Coscinodiscus bouvet* Karsten
*Chaetoceros neglectum* Karsten
*Coscinodiscus variolatus* Castracane
*Chaetoceros Chunii* Karsten
*Coscinodiscus Chunii* Karsten
*Rhizosolenia rhombus* Karsten
*Coscinodiscus lentigenosis* Janisch
*Chuniella oceanica* (Karsten) Hendey
*Pleurosigma directum* Grunow
*Thalassiosira antarctica* Comber
*Chaetoceros Schimperianum* Karsten
*Coscinodiscus eta* Karsten

St. **479**. 13. xi. 30. 53° 38¾′ S, 40° 21¾′ W. 100–0 m.
Temp. −0·62° C. Salinity 33·91 $^{\circ}/_{\circ\circ}$. *p*H 7·99. $P_2O_5$ 86.

*Corethron criophilum* Castracane
*Chaetoceros criophilum* Castracane
*Rhizosolenia alata* Brightwell
*Rhizosolenia styliformis* Brightwell
*Fragilariopsis antarctica* (Castracane) Hustedt
*Charcotia bifrons* (Castracane) Peragallo
*Dactyliosolen antarcticus* Castracane
*Asteromphalus Hookerii* Ehrenberg
*Biddulphia striata* Karsten
*Chaetoceros neglectum* Karsten
*Coscinodiscus variolatus* Castracane
*Rhizosolenia simplex* Karsten
*Nitzschia pelagica* Karsten
*Nitzschia seriata* Cleve
*Coscinodiscus lentigenosis* Janisch
*Coscinodiscus subtilis* Ehrenberg
*Actinocyclus Janus* Karsten
*Coscinodiscus nitidus* Gregory
*Thalassiosira antarctica* Comber
*Rhizosolenia rhombus* Karsten
*Chaetoceros sociale* Lauder
*Chaetoceros atlanticum* Cleve
*Rhizosolenia bidens* Karsten
*Coscinodiscus decrescens* Grunow
*Chaetoceros Schimperianum* Karsten
*Chaetoceros Chunii* Karsten

St. **480**. 13. xi. 30. 53° 40½′ S, 39° 54′ W. 100–0 m.
Temp. −0·58° C. Salinity 33·88 $^{\circ}/_{\circ\circ}$. *p*H 8·03. $P_2O_5$ 106.

*Chaetoceros criophilum* Castracane
*Corethron criophilum* Castracane
*Rhizosolenia hebetata* Bailey
*Coscinodiscus radiatus* Ehrenberg
*Rhizosolenia styliformis* Brightwell
*Rhizosolenia alata* Brightwell
*Nitzschia seriata* Cleve
*Fragilariopsis antarctica* (Castracane) Hustedt
*Biddulphia striata* Karsten
*Chaetoceros radiculum* Karsten
*Asteromphalus Hookerii* Ehrenberg
*Eucampia balaustium* Castracane
*Actinocyclus Janus* Karsten
*Chaetoceros sociale* Lauder
*Coscinodiscus subtilis* Ehrenberg
*Coscinodiscus lentigenosis* Janisch
*Chaetoceros Chunii* Karsten
*Coscinodiscus oculoides* Karsten

St. **481**. 13/14. xi. 30. 53° 44¼′ S, 39° 29½′ W. 100–0 m.
Temp. −0·50° C. Salinity 33·92 $^{\circ}/_{\circ\circ}$. *p*H 8·03. $P_2O_5$ 90.

*Corethron criophilum* Castracane
*Chaetoceros criophilum* Castracane
*Thalassiosira antarctica* Comber
*Eucampia balaustium* Castracane
*Fragilariopsis antarctica* (Castracane) Hustedt
*Rhizosolenia hebetata* Bailey
*Chaetoceros neglectum* Karsten
*Coscinodiscus subtilis* Ehrenberg
*Coscinodiscus lentigenosis* Janisch
*Chaetoceros Chunii* Karsten
*Rhizosolenia styliformis* Brightwell
*Coscinodiscus oculoides* Karsten
*Biddulphia striata* Karsten
*Chuniella oceanica* (Karsten) Hendey
*Actinocyclus intermittens* Karsten
*Cerataulina Bergonii* Peragallo

St. **482**. 14. xi. 30. 53° 46¾′ S, 39° 04¾′ W. 100–0 m.
Temp. −0·58° C. Salinity 33·96 ‰. *p*H 8·02. $P_2O_5$ 93.

*Corethron criophilum* Castracane
*Chaetoceros criophilum* Castracane
*Rhizosolenia styliformis* Brightwell
*Fragilariopsis antarctica* (Castracane) Hustedt
*Biddulphia striata* Karsten
*Rhizosolenia alata* Brightwell
*Rhizosolenia hebetata* Bailey
*Thalassiosira antarctica* Comber
*Chaetoceros sociale* Lauder
*Eucampia balaustium* Castracane
*Chaetoceros Chunii* Karsten
*Hyalodiscus chromatoaster* Karsten
*Coscinodiscus oculoides* Karsten
*Actinoptychus senarius* Ehrenberg
*Nitzschia seriata* Cleve
*Hyalodiscus kerguelensis* Karsten
*Coscinodiscus subtilis* Ehrenberg
*Coscinodiscus lentiginosus* Janisch

St. **483**. 14. xi. 30. 53° 54¼′ S, 38° 25½′ W. 100–0 m.
Temp. −0·50° C. Salinity 34·03 ‰. *p*H 7·98. $P_2O_5$ 98.

*Corethron criophilum* Castracane

St. **501**. 22. xi. 30. 53° 41½′ S, 33° 28′ W. 100–0 m.
Temp. −0·93° C. Salinity 33·87 ‰. *p*H 7·99. $P_2O_5$ 94.

*Corethron criophilum* Castracane
*Chaetoceros criophilum* Castracane
*Rhizosolenia hebetata* Bailey
*Rhizosolenia alata* Brightwell
*Eucampia balaustium* Castracane
*Chaetoceros neglectum* Karsten
*Coscinodiscus excentricus* Ehrenberg
*Biddulphia striata* Karsten
*Fragilariopsis antarctica* (Castracane) Hustedt
*Actinocyclus Janus* Karsten
*Rhizosolenia curvata* Zacharias
*Thalassiosira antarctica* Comber
*Coscinodiscus variolatus* Castracane
*Chaetoceros Chunii* Karsten
*Melosira sphaerica* Karsten

St. **502**. 22. xi. 30. 53° 47′ S, 33° 51¾′ W. 100–0 m.
Temp. −0·80° C. Salinity 33·82 ‰. *p*H 8·00. $P_2O_5$ 91.

*Chaetoceros criophilum* Castracane
*Corethron criophilum* Castracane
*Rhizosolenia hebetata* Bailey
*Coscinodiscus subtilis* Ehrenberg
*Nitzschia seriata* Cleve
*Chaetoceros sociale* Lauder
*Biddulphia striata* Karsten
*Coscinodiscus lentiginosus* Janisch
*Coscinodiscus variolatus* Castracane

St. **503**. 23. xi. 30. 53° 53¾′ S, 34° 12¾′ W. 100–0 m.
Temp. −1·12° C. Salinity 33·89 ‰. *p*H 8·00. $P_2O_5$ 89.

*Chaetoceros criophilum* Castracane
*Rhizosolenia hebetata* Bailey
*Corethron criophilum* Castracane
*Asteromphalus Roperianus* Ralfs ex Pritchard
*Nitzschia seriata* Cleve
*Thalassiosira antarctica* Comber
*Coscinodiscus variolatus* Castracane
*Biddulphia striata* Karsten
*Actinocyclus Janus* Karsten
*Coscinodiscus lentigenosis* Janisch

St. **504**. 23. xi. 30. 54° 00¾′ S, 34° 33½′ W. 100–0 m.
Temp. −1·31° C. Salinity 33·91 ‰. *p*H 8·00. $P_2O_5$ 93.

*Chaetoceros criophilum* Castracane
*Rhizosolenia hebetata* Bailey
*Corethron criophilum* Castracane
*Fragilariopsis antarctica* (Castracane) Hustedt
*Thalassiosira antarctica* Comber
*Coscinodiscus lentiginosus* Janisch

St. **505**. 23. xi. 30. 54° 07¼′ S, 34° 54¾′ W. 100–0 m.
Temp. −0·68° C. Salinity 33·90 ‰. *p*H 8·05. $P_2O_5$ 86.

*Chaetoceros criophilum* Castracane
*Dactyliosolen antarcticus* Castracane
*Coscinodiscus subtilis* Ehrenberg
*Rhizosolenia hebetata* Bailey
*Biddulphia striata* Karsten
*Fragilariopsis antarctica* (Castracane) Hustedt
*Chuniella oceanica* (Karsten) Hendey
*Chaetoceros cruciatum* Karsten
*Thalassiosira antarctica* Comber
*Corethron criophilum* Castracane
*Actinocyclus Janus* Karsten
*Actinocyclus complanatus* Castracane
*Chaetoceros boreale* Bailey
*Eucampia balaustium* Castracane
*Coscinodiscus variolatus* Castracane
*Asteromphalus Roperianus* Ralfs ex Pritchard
*Rhizosolenia alata* Brightwell
*Chaetoceros sociale* Lauder
*Chaetoceros atlanticum* Cleve
*Coscinodiscus trigonus* Karsten

St. **506**. 23. xi. 30. 54° 14′ S, 35° 15½′ W. 100–0 m.
Temp. −0·56° C. Salinity 33·92 ‰. *p*H 8·07. $P_2O_5$ 81.

*Chaetoceros criophilum* Castracane
*Corethron criophilum* Castracane
*Rhizosolenia hebetata* Bailey
*Coscinodiscus trigonus* Karsten
*Coscinodiscus subtilis* Ehrenberg
*Dactyliosolen antarcticus* Castracane
*Fragilariopsis antarctica* (Castracane) Hustedt
*Chaetoceros neglectum* Karsten
*Eucampia balaustium* Castracane
*Biddulphia striata* Karsten
*Chaetoceros Chunii* Karsten
*Coscinodiscus variolatus* Castracane
*Thalassiosira antarctica* Comber
*Rhizosolenia alata* Brightwell
*Actinocyclus Janus* Karsten

St. **507**. 23. xi. 30. 54° 19½′ S, 35° 33½′ W. 100–0 m.
Temp. −0·70° C. Salinity 33·91 ‰. *p*H 8·02. $P_2O_5$ 87.

*Thalassiosira antarctica* Comber
*Corethron criophilum* Castracane
*Chaetoceros criophilum* Castracane
*Coscinodiscus trigonus* Karsten
*Eucampia balaustium* Castracane
*Coscinodiscus decrescens* Grunow
*Dactyliosolen antarcticus* Castracane
*Chaetoceros sociale* Lauder
*Fragilariopsis antarctica* (Castracane) Hustedt
*Rhizosolenia alata* Brightwell
*Coscinodiscus centralis* Ehrenberg
*Chaetoceros didymum* Ehrenberg
*Rhizosolenia bidens* Karsten

St. **508**. 24. xi. 30. 55° 08′ S, 33° 35′ W. 100–0 m.
Temp. −0·92° C. Salinity 33·75 ‰. *p*H 8·04. $P_2O_5$ 71.

*Chaetoceros criophilum* Castracane
*Corethron criophilum* Castracane
*Thalassiosira gravida* Cleve
*Thalassiosira antarctica* Comber
*Rhizosolenia hebetata* Bailey
*Biddulphia striata* Karsten
*Eucampia balaustium* Castracane
*Fragilariopsis antarctica* (Castracane) Hustedt
*Chaetoceros sociale* Lauder
*Dactyliosolen antarcticus* Castracane
*Rhizosolenia alata* Brightwell
*Coscinodiscus trigonus* Karsten
*Ethmodiscus gazellae* (Janisch) Hustedt
*Nitzschia seriata* Cleve
*Chaetoceros neglectum* Karsten
*Actinocyclus Janus* Karsten
*Coscinodiscus variolatus* Castracane
*Nitzschia pelagica* Karsten
*Chaetoceros Chunii* Karsten
*Coscinodiscus lentiginosus* Janisch
*Asteromphalus Roperianus* Ralfs ex Pritchard
*Rhizosolenia rhombus* Karsten
*Actinocyclus bifrons* Karsten
*Coscinodiscus oculus-Iridis* Ehrenberg
*Melosira sphaerica* Karsten

St. **509**. 24. xi. 30. 55° 05½′ S, 34° 01′ W. 100–0 m.
Temp. −0·81° C. Salinity 33·80 ‰. *p*H 8·06. $P_2O_5$ 75.

*Chaetoceros criophilum* Castracane
*Eucampia balaustium* Castracane
*Thalassiosira antarctica* Comber
*Coscinodiscus subtilis* Ehrenberg
*Thalassiosira gravida* Cleve
*Coscinodiscus trigonus* Karsten
*Rhizosolenia hebetata* Bailey
*Biddulphia striata* Karsten
*Dactyliosolen antarcticus* Castracane
*Chaetoceros sociale* Lauder
*Coscinodiscus bouvet* Karsten
*Asteromphalus Roperianus* Ralfs ex Pritchard
*Melosira sphaerica* Karsten
*Rhizosolenia alata* Brightwell
*Chaetoceros atlanticum* Cleve
*Chaetoceros boreale* Bailey

St. **510**. 25. xi. 30. 4·8 miles N 70° E of Clerke Rocks, South Georgia. 100–0 m.
Temp. −0·88° C. Salinity 33·86 ‰. *p*H 8·06. $P_2O_5$ 79.

*Chaetoceros criophilum* Castracane
*Eucampia balaustium* Castracane
*Rhizosolenia hebetata* Bailey
*Thalassiosira antarctica* Comber
*Coscinodiscus subtilis* Ehrenberg
*Biddulphia striata* Karsten
*Coscinodiscus trigonus* Karsten
*Thalassiosira gravida* Cleve
*Dactyliosolen antarcticus* Castracane
*Chaetoceros sociale* Lauder
*Chaetoceros neglectum* Karsten
*Asteromphalus Roperianus* Ralfs ex Pritchard
*Chaetoceros atlanticum* Cleve
*Rhizosolenia alata* Brightwell
*Melosira sphaerica* Karsten
*Ethmodiscus gazellae* (Janisch) Hustedt
*Asteromphalus parvulus* Karsten
*Rhizosolenia simplex* Karsten
*Actinocyclus bifrons* Karsten
*Coscinodiscus variolatus* Castracane

St. **511**. 25. xi. 30. 54° 58¼′ S, 34° 51¼′ W. 100–0 m.
Temp. −0·85° C. Salinity 33·87 ‰. *p*H 8·05. $P_2O_5$ 81.

*Chaetoceros criophilum* Castracane
*Rhizosolenia alata* Brightwell
*Corethron criophilum* Castracane
*Coscinodiscus subtilis* Ehrenberg
*Biddulphia striata* Karsten
*Rhizosolenia hebetata* Bailey
*Eucampia balaustium* Castracane
*Thalassiosira gravida* Cleve
*Fragilariopsis antarctica* (Castracane) Hustedt
*Chaetoceros sociale* Lauder
*Dactyliosolen antarcticus* Castracane
*Thalassiosira antarctica* Comber

St. **512**. 25. xi. 30. 54° 56′ S, 35° 17′ W. 100–0 m.
Temp. −0·55° C. Salinity 33·87 ‰. *p*H 8·07. $P_2O_5$ 79.

*Chaetoceros sociale* Lauder
*Chaetoceros criophilum* Castracane
*Thalassiosira gravida* Cleve
*Rhizosolenia styliformis* Brightwell
*Chaetoceros neglectum* Karsten
*Biddulphia striata* Karsten
*Charcotia bifrons* (Castracane) Peragallo
*Thalassiosira subtilis* (Ostenfeldt) Gran
*Eucampia balaustium* Castracane
*Dactyliosolen laevis* Karsten
*Corethron criophilum* Castracane
*Fragilariopsis antarctica* (Castracane) Hustedt
*Rhizosolenia alata* Brightwell
*Coscinodiscus subtilis* Ehrenberg

St. **513**. 25. xi. 30. 54° 53¾′ S, 35° 42½′ W. 100–0 m.
Temp. −0·42° C. Salinity 33·87 ‰. *p*H 8·07. $P_2O_5$ 81.

*Chaetoceros sociale* Lauder
*Thalassiosira antarctica* Comber
*Chaetoceros criophilum* Castracane
*Thalassiosira gravida* Cleve
*Rhizosolenia alata* Brightwell
*Chaetoceros neglectum* Karsten
*Fragilariopsis antarctica* (Castracane) Hustedt
*Biddulphia striata* Karsten

*Eucampia balaustium* Castracane
*Corethron criophilum* Castracane
*Dactyliosolen antarcticus* Castracane
*Coscinodiscus subtilis* Ehrenberg
*Chaetoceros atlanticum* Cleve

St. **542**. 20. xii. 30. 62° 08′ S, 57° 28½′ W. 100–0 m.
Temp. −0·17° C. Salinity 34·13 °/$_{00}$. *p*H 8·01. $P_2O_5$ 137.

*Thalassiosira antarctica* Comber
*Corethron criophilum* Castracane
*Rhizosolenia alata* Brightwell
*Fragilariopsis antarctica* (Castracane) Hustedt
*Eucampia balaustium* Castracane
*Licmophora Lyngbyei* (Kützing) Grunow ex Van Heurck
*Coscinodiscus stellaris* Roper
*Coscinodiscus bouvet* Karsten
*Biddulphia striata* Karsten

St. **543**. 20. xii. 30. 62° 16′ S, 57° 20′ W. 100–0 m.
Temp. 0·30° C. Salinity 34·21 °/$_{00}$. *p*H 8·02. $P_2O_5$ 115.

*Corethron criophilum* Castracane
*Rhizosolenia alata* Brightwell
*Thalassiosira antarctica* Comber
*Actinocyclus intermittens* Karsten
*Coscinodiscus stellaris* Roper

St. **544**. 20. xii. 30. 62° 26¼′ S, 57° 15½′ W. 100–0 m.
Temp. −0·08° C. Salinity 34·28 °/$_{00}$. *p*H 8·00. $P_2O_5$ 106.

*Corethron criophilum* Castracane
*Rhizosolenia alata* Brightwell
*Coscinodiscus stellaris* Roper
*Fragilariopsis antarctica* (Castracane) Hustedt
*Licmophora Lyngbyei* (Kützing) Grunow ex Van Heurck
*Coscinodiscus bouvet* Karsten
*Coscinodiscus variolatus* Castracane
*Actinocyclus intermittens* Karsten
*Eucampia balaustium* Castracane
*Biddulphia striata* Karsten

St. **551**. 22. xii. 30. 63° 17½′ S, 60° 55¾′ W. 100–0 m.
Temp. 0·91° C. Salinity 34·12 °/$_{00}$. *p*H 8·02. $P_2O_5$ 100.

*Corethron criophilum* Castracane
*Chaetoceros criophilum* Castracane
*Actinocyclus intermittens* Karsten
*Charcotia bifrons* (Castracane) Peragallo
*Coscinodiscus stellaris* Roper
*Coscinodiscus bouvet* Karsten

St. **552**. 22. xii. 30. 63° 26¼′ S, 60° 45′ W. 100–0 m.
Temp. 0·72° C. Salinity 34·14 °/$_{00}$. *p*H 8·02. $P_2O_5$ 108.

*Corethron criophilum* Castracane
*Thalassiosira antarctica* Comber
*Fragilariopsis antarctica* (Castracane) Hustedt
*Rhizosolenia alata* Brightwell
*Coscinodiscus stellaris* Roper
*Charcotia bifrons* (Castracane) Peragallo
*Cocconeis imperatrix* Schmidt

St. **553**. 22. xii. 30. 63° 33¾′ S, 60° 33½′ W. 100–0 m.
Temp. 0·85° C. Salinity 34·18 °/$_{00}$. *p*H 8·02. $P_2O_5$ 110.

*Corethron criophilum* Castracane
*Thalassiosira antarctica* Comber
*Rhizosolenia alata* Brightwell
*Coscinodiscus stellaris* Roper

St. **570**. 4. i. 31. 69° 07½′ S, 99° 49¾′ W. 100–0 m.
Temp. −0·68° C. Salinity 33·10 °/$_{00}$.

*Fragilariopsis antarctica* (Castracane) Hustedt
*Chaetoceros criophilum* Castracane
*Nitzschia seriata* Cleve
*Coscinodiscus lentiginosus* Janisch
*Actinocyclus intermittens* Karsten
*Chaetoceros Chunii* Karsten
*Dactyliosolen antarcticus* Castracane
*Ethmodiscus subtilis* Karsten

*Charcotia bifrons* (Castracane) Peragallo
*Eucampia balaustium* Castracane
*Asteromphalus Hookerii* Ehrenberg

**St. 574.** 7. i. 31. 67° 43′ S, 94° 18¼′ W. 100–0 m.
Temp. −0·68° C. Salinity 33·71 ‰.

*Chaetoceros criophilum* Castracane
*Fragilariopsis antarctica* (Castracane) Hustedt
*Rhizosolenia alata* Brightwell
*Corethron criophilum* Castracane
*Chaetoceros dichaeta* Ehrenberg
*Chaetoceros Chunii* Karsten
*Rhizosolenia Chunii* Karsten

**St. 575.** 8. i. 31. 67° 53¼′ S, 91° 23′ W. 100–0 m.
Temp. −1·47° C. Salinity 33·37 ‰.

*Corethron criophilum* Castracane
*Chaetoceros neglectum* Karsten
*Rhizosolenia polydactyla* Castracane
*Rhizosolenia Chunii* Karsten
*Fragilariopsis antarctica* (Castracane) Hustedt
*Coscinodiscus radiatus* Ehrenberg
*Rhizosolenia alata* Brightwell
*Biddulphia striata* Karsten
*Chaetoceros criophilum* Castracane
*Charcotia bifrons* (Castracane) Peragallo
*Nitzschia seriata* Cleve
*Chaetoceros sociale* Lauder
*Coscinodiscus lentiginosus* Janisch
*Ethmodiscus subtilis* Karsten
*Asteromphalus parvulus* Karsten
*Melosira sphaerica* Karsten

**St. 576.** 8. i. 31. 67° 50′ S, 89° 12¾′ W. 100–0 m.
Temp. −1·15° C. Salinity 33·35 ‰.

*Chaetoceros neglectum* Karsten
*Corethron criophilum* Castracane
*Nitzschia seriata* Cleve
*Thalassiosira antarctica* Comber
*Rhizosolenia alata* Brightwell
*Chaetoceros criophilum* Castracane
*Fragilariopsis antarctica* (Castracane) Hustedt
*Chaetoceros dichaeta* Ehrenberg
*Chaetoceros atlanticum* Cleve
*Actinocyclus bifrons* Karsten
*Charcotia bifrons* (Castracane) Peragallo
*Coscinodiscus lentiginosus* Janisch
*Eucampia balaustium* Castracane
*Asteromphalus parvulus* Karsten

**St. 577.** 9. i. 31. 68° 06½′ S, 85° 10′ W. 100–0 m.
Temp. −0·20° C. Salinity 33·30 ‰.

*Chaetoceros neglectum* Karsten
*Nitzschia seriata* Cleve
*Corethron criophilum* Castracane
*Fragilariopsis antarctica* (Castracane) Hustedt
*Thalassiosira antarctica* Comber
*Chaetoceros criophilum* Castracane
*Chaetoceros dichaeta* Ehrenberg
*Chaetoceros Schimperianum* Karsten
*Rhizosolenia Chunii* Karsten
*Rhizosolenia alata* Brightwell
*Thalassiothrix antarctica* Karsten
*Synedra pelagica* Hendey
*Eucampia balaustium* Castracane
*Biddulphia striata* Karsten
*Asteromphalus Hookerii* Ehrenberg
*Asteromphalus parvulus* Karsten
*Coscinodiscus lentiginosus* Janisch

**St. 578.** 9. i. 31. 67° 54′ S, 81° 26¾′ W. 100–0 m.
Temp. −1·20° C. Salinity 33·21 ‰.

*Corethron criophilum* Castracane
*Rhizosolenia alata* Brightwell
*Rhizosolenia polydactyla* Castracane
*Rhizosolenia Chunii* Karsten
*Chaetoceros neglectum* Karsten
*Fragilariopsis antarctica* (Castracane) Hustedt
*Thalassiosira antarctica* Comber
*Chaetoceros criophilum* Castracane
*Biddulphia striata* Karsten
*Asteromphalus Hookerii* Ehrenberg
*Charcotia bifrons* (Castracane) Peragallo.

St. **580**. 10. i. 31. 67° 41½′ S, 75° 56½′ W. 100–0 m.
Temp. −0·10° C. Salinity 33·24 °/oo.

*Corethron criophilum* Castracane
*Rhizosolenia alata* Brightwell
*Chaetoceros neglectum* Karsten
*Rhizosolenia Chunii* Karsten
*Nitzschia seriata* Cleve
*Chaetoceros dichaeta* Ehrenberg
*Rhizosolenia polydactyla* Castracane
*Fragilariopsis antarctica* (Castracane) Hustedt
*Thalassiosira antarctica* Comber
*Chaetoceros criophilum* Castracane
*Biddulphia striata* Karsten
*Eucampia balaustium* Castracane
*Rhizosolenia truncata* Karsten
*Asteromphalus Hookerii* Ehrenberg

St. **615**. 13. ii. 31. 60° 55½′ S, 47° 58¼′ W. 100–0 m.
Temp. −0·68° C. Salinity 32·73 °/oo.

*Corethron criophilum* Castracane
*Ethmodiscus subtilis* Karsten
*Chaetoceros criophilum* Castracane
*Rhizosolenia alata* Brightwell
*Coscinodiscus stellaris* Roper
*Fragilariopsis antarctica* (Castracane) Hustedt

St. **617**. 18. ii. 31. 60° 22′ S, 45° 40′ W. 100–0 m.
Temp. −0·92° C. Salinity 33·44 °/oo.

*Corethron criophilum* Castracane
*Fragilariopsis antarctica* (Castracane) Hustedt
*Coscinodiscus stellaris* Roper

St. **619**. 19. ii. 31. 59° 33′ S, 43° 07¼′ W. 100–0 m.
Temp. −0·52° C. Salinity 32·79 °/oo.

*Corethron criophilum* Castracane
*Chaetoceros criophilum* Castracane
*Fragilariopsis antarctica* (Castracane) Hustedt
*Coscinodiscus stellaris* Roper
*Ethmodiscus subtilis* Karsten
*Asteromphalus Hookerii* Ehrenberg

St. **626**. 22. ii. 31. 57° 22′ S, 26° 29¾′ W. 100–0 m.
Temp. −0·09° C. Salinity 33·62 °/oo.

*Corethron criophilum* Castracane
*Chaetoceros criophilum* Castracane

St. **659**. 26. iii. 31. 53° 56½′ S, 40° 09½′ W. 100–0 m.
Temp. 2·76° C. Salinity 33·89 °/oo. *p*H 7·98.

*Rhizosolenia alata* Brightwell
*Rhizosolenia curvata* Zacharias
*Chaetoceros criophilum* Castracane
*Rhizosolenia simplex* Karsten
*Coscinodiscus oculoides* Karsten
*Rhizosolenia hebetata* Bailey
*Fragilariopsis antarctica* (Castracane) Hustedt
*Coscinodiscus lineatus* Ehrenberg
*Dactyliosolen antarcticus* Castracane

St. **661**. 2. iv. 31. 57° 36′ S, 29° 45′ W. 100–0 m.
Temp. −0·81° C. Salinity 33·33 °/oo. *p*H 7·97. $P_2O_5$ 105. $NO_3$ 510.

*Chaetoceros criophilum* Castracane
*Rhizosolenia styliformis* Brightwell
*Asteromphalus Hookerii* Ehrenberg
*Corethron criophilum* Castracane
*Fragilariopsis antarctica* (Castracane) Hustedt
*Rhizosolenia hebetata* Bailey
*Coscinodiscus oculoides* Karsten
*Dactyliosolen antarcticus* Castracane
*Coscinodiscus curvatulus* Grunow
*Asteromphalus heptactis* (Brébisson) Ralfs
*Ethmodiscus subtilis* Karsten
*Charcotia bifrons* (Castracane) M. Peragallo

**St. 663.** 4. iv. 31. 53° $33\frac{1}{2}'$ S, 30° 23′ W. 100–0 m.
Temp. 0·51° C. Salinity 33·60 $^{\circ}/_{\circ\circ}$. *p*H 7·98. $P_2O_5$ 98. $NO_3$ 490.

*Chaetoceros criophilum* Castracane
*Corethron criophilum* Castracane
*Rhizosolenia styliformis* Brightwell

**St. 664.** 15. iv. 31. Three miles S 60° E of Jason Island, South Georgia. 100–0 m.
Temp. 1·90° C. Salinity 33·71 $^{\circ}/_{\circ\circ}$.

*Corethron criophilum* Castracane
*Coscinodiscus curvatulus* Grunow
*Coscinodiscus tumidus* Janisch
*Chaetoceros peruvianum* Brightwell
*Dactyliosolen antarcticus* Castracane
*Actinocyclus umbonatus* Castracane
*Coscinodiscus subtilis* Ehrenberg
*Cocconeis pinnata* Gregory ex Greville
*Chaetoceros criophilum* Castracane
*Coscinodiscus bouvet* Karsten
*Coscinodiscus simbirskianus* Grunow
*Coscinodiscus oculoides* Karsten
*Stictodiscus affinis* Castracane

**St. 666.** 17/18. iv. 31. 49° $58\frac{3}{4}'$ S, 30° 10′ W. 100–0 m.
Temp. 2·71° C. Salinity 33·84 $^{\circ}/_{\circ\circ}$. *p*H 7·96. $P_2O_5$ 105. $NO_3$ 470.

*Dactyliosolen antarcticus* Castracane
*Chaetoceros criophilum* Castracane
*Chaetoceros Lorenzianum* Grunow
*Rhizosolenia alata* Brightwell
*Chaetoceros laciniosum* Schütt
*Chaetoceros dichaeta* Ehrenberg
*Corethron criophilum* Castracane
*Fragilariopsis antarctica* (Castracane) Hustedt
*Coscinodiscus lineatus* Ehrenberg
*Rhizosolenia simplex* Karsten
*Synedra pelagica* Hendey
*Chaetoceros decipiens* Cleve
*Coscinodiscus pyrenoidophorus* Karsten
*Coscinodiscus trigonus* Karsten
*Coscinodiscus curvatulus* Grunow
*Coscinodiscus kryophilus* Grunow
*Chaetoceros atlanticum* Cleve
*Coscinodiscus gracilis* Karsten
*Asteromphalus Hookerii* Ehrenberg
*Guinardia flaccida* (Castracane) Peragallo
*Rhizosolenia curvata* Zacharias
*Asteromphalus Roperianus* Ralfs
*Actinocyclus elegans* Karsten
*Coscinodiscus incurvus* Karsten
*Tropidoneis antarctica* Grunow
*Coscinodiscus oppositus* Karsten

**St. 670.** 22. iv. 31. 44° 52′ S, 30° 17′ W. 100–0 m.
Temp. 8·10° C. Salinity 34·18 $^{\circ}/_{\circ\circ}$. *p*H 8·09. $P_2O_5$ 74.

*Corethron criophilum* Castracane
*Coscinodiscus radiatus* Ehrenberg
*Chaetoceros coarctatum* Lauder
*Dactyliosolen antarcticus* Castracane
*Nitzschia seriata* Cleve
*Fragilariopsis antarctica* (Castracane) Hustedt
*Coscinodiscus curvatulus* Grunow
*Licmophora luxuriosa* Heiden et Kolbe
*Cocconeis scutellum* Ehrenberg
*Biddulphia aurita*, var. *obtusa* (Kützing) Hustedt
*Rhizosolenia alata* Brightwell
*Thalassiothrix longissima* Cleve et Grunow
*Rhizosolenia curvata* Zacharias
*Coscinodiscus centralis* Ehrenberg
*Coscinodiscus excentricus* Ehrenberg

**St. 671.** 22/23. iv. 31. 43° 08′ S, 30° $15\frac{3}{4}'$ W. 100–0 m.
Temp. 9·70° C. Salinity 34·32 $^{\circ}/_{\circ\circ}$. *p*H 8·09. $P_2O_5$ 73.

*Rhizosolenia alata* Brightwell
*Coscinodiscus radiatus* Ehrenberg
*Synedra pelagica* Hendey
*Coscinodiscus excentricus* Ehrenberg
*Fragilaria striatula* Lyngbye
*Rhizosolenia curvata* Zacharias

St. **673**. 24/25. iv. 31. 38° 7′ S, 30° 10¼′ W. 100–0 m.
Temp. 17·39° C. Salinity 35·16 °/$_{00}$. *p*H 8·17. $P_2O_5$ 9. $NO_3$ 60.

*Planktoniella sol* (Wallich) Schütt
*Coscinodiscus curvatulus* Grunow
*Coscinodiscus radiatus* Ehrenberg
*Synedra pelagica* Hendey

St. **675**. 26. iv. 31. 34° 08′ S, 29° 50½′ W. 100–0 m.
Temp. 19·02° C. Salinity 35·44 °/$_{00}$. *p*H 8·16. $P_2O_5$ 10. $NO_3$ 7.

*Planktoniella sol* (Wallich) Schütt
*Asterolampra marylandica* Ehrenberg
*Rhizosolenia Castracani* Peragallo
*Hemidiscus cuneiformis* Wallich
*Rhizosolenia alata* Brightwell
*Rhizosolenia Bergonii* H. Peragallo
*Coscinodiscus marginatus* Ehrenberg
*Coscinodiscus curvatulus* Grunow
*Chaetoceros decipiens* Cleve
*Guinardia flaccida* (Castracane) Peragallo

St. **677**. 27/28. iv. 31. 31° 16¼′ S, 29° 56½′ W. 100–0 m.
Temp. 21·43° C. Salinity 35·68 °/$_{00}$. *p*H 8·18. $P_2O_5$ 8. $NO_3$ 6.

*Hemiaulus Hauckii* Grunow
*Hemidiscus cuneiformis* Wallich
*Coscinodiscus curvatulus* Grunow
*Coscinodiscus marginatus* Ehrenberg
*Asterolampra marylandica* Ehrenberg
*Coscinodiscus Charcotii* M. Peragallo
*Fragilaria striatula* Lyngbye
*Coscinodiscus oculus-Iridis* Ehrenberg
*Asteromphalus heptactis* (Brébisson) Ralfs

St. **679**. 29. iv. 31. 26° 06½′ S, 30° 06¼′ W. 100–0 m.
Temp. 25·24° C. Salinity 36·56 °/$_{00}$. *p*H 8·25. $P_2O_5$ 0. $NO_3$ 6.

*Hemiaulus Hauckii* Grunow
*Rhizosolenia curvata* Zacharias
*Hemidiscus cuneiformis* Wallich

St. **681**. 1. v. 31. 21° 13′ S, 29° 55¼′ W. 100–0 m.
Temp. 27·20° C. Salinity 37·34 °/$_{00}$. *p*H 8·30. $P_2O_5$ 0. $NO_3$ 2.

*Hemidiscus cuneiformis* Wallich
*Coscinodiscus radiatus* Ehrenberg
*Rhizosolenia styliformis* Brightwell
*Asterolampra marylandica* Ehrenberg
*Melosira sulcata* (Ehrenberg) Kützing
*Hemiaulus Hauckii* Grunow
*Chaetoceros coarctatum* Lauder
*Chaetoceros atlanticum* Cleve
*Rhizosolenia setigera* Brightwell
*Asteromphalus heptactis* (Brébisson) Ralfs

St. **684**. 3. v. 31. 15° 38′ S, 29° 51½′ W. 100–0 m.
Temp. 26·80° C. Salinity 37·24 °/$_{00}$. *p*H 8·28. $P_2O_5$ 0. $NO_3$ 2.

*Planktoniella sol* (Wallich) Schütt
*Rhizosolenia Castracani* Peragallo
*Asterolampra marylandica* Ehrenberg
*Rhizosolenia Bergonii* H. Peragallo
*Hemidiscus cuneiformis* Wallich
*Rhizosolenia Shrubsolii* Cleve
*Asterolampra Grevillii* (Wallich) Greville

St. **687**. 5. v. 31. 09° 47′ S, 29° 51′ W. 100–0 m.
Temp. 27·51° C. Salinity 36·55 °/$_{00}$. *p*H 8·28. $P_2O_5$ 0. $NO_3$ 5.

*Rhizosolenia alata* Brightwell
*Asterolampra marylandica* Ehrenberg
*Rhizosolenia Bergonii* H. Peragallo

St. **690**. 7/8. v. 31. 3° 19′ S, 29° 58′ W. 100–0 m.
Temp. 28·20° C. Salinity 36·00 °/$_{00}$. *p*H 8·28. $P_2O_5$ 0. $NO_3$ 4.

*Hemidiscus cuneiformis* Wallich
*Planktoniella sol* (Wallich) Schütt
*Asterolampra marylandica* Ehrenberg
*Chaetoceros convolutum* Castracane

St. **719**. 13. xi. 31. 54° 00′ S, 60° 00′ W. 90–0 m.
Temp. 5·41° C. Salinity 34·06 $^{\circ}/_{\circ\circ}$. *p*H 8·21.

*Coscinodiscus centralis* Ehrenberg
*Rhizosolenia annulata* Karsten
*Hyalodiscus stelliger* Bailey
*Actinoptychus senarius* Ehrenberg

St. **721**. 13. xi. 31. 53° 58·5′ S, 61° 59·1′ W. 100–0 m.
Temp. 5·42° C. Salinity 34·12 $^{\circ}/_{\circ\circ}$. *p*H 8·22.

*Rhizosolenia annulata* Karsten
*Actinoptychus senarius* Ehrenberg
*Coscinodiscus centralis* Ehrenberg
*Hyalodiscus stelliger* Bailey
*Coscinodiscus gigas* Ehrenberg

St. **722**. 14. xi. 31. 53° 55·8′ S, 64° 14′ W. 100–0 m.
Temp. 5·64° C. Salinity 33·79 $^{\circ}/_{\circ\circ}$. *p*H 8·27.

*Thalassiosira decipiens* (Grunow) Jörgensen
*Stephanopyxis turris* (Greville) Ralfs ex Pritchard
*Coscinodiscus gigas* Ehrenberg
*Ditylum Brightwellii* (West) Grunow ex Van Heurck
*Coscinodiscus radiatus* Ehrenberg
*Chaetoceros decipiens* Cleve
*Rhizosolenia annulata* Karsten
*Rhizosolenia hebetata* Bailey

St. **723**. 14. xi. 31. 53° 56·5′ S, 66° 05′ W. 80–0 m.
Temp. 6·30° C. Salinity 33·04 $^{\circ}/_{\circ\circ}$. *p*H 8·25.

*Stephanopyxis turris* (Greville) Ralfs ex Pritchard
*Thalassiosira decipiens* (Grunow) Jörgensen
*Ditylum Brightwellii* (West) Grunow ex Van Heurck
*Coscinodiscus radiatus* Ehrenberg
*Coscinodiscus gigas* Ehrenberg
*Chaetoceros decipiens* Cleve

St. **1356**. 3. v. 34. 60° 12·8′ S, 19° 37·5′ E. 100–0 m.
Temp. −0·79° C. Salinity 33·89 $^{\circ}/_{\circ\circ}$. *p*H 8·29.

*Dactyliosolen antarcticus* Castracane
*Corethron criophilum* Castracane (spineless chains)
*Fragilariopsis antarctica* (Castracane) Hustedt
*Corethron criophilum* Castracane
*Thalassiothrix longissima* Cleve et Grunow
*Rhizosolenia alata* Brightwell
*Chaetoceros criophilum* Castracane
*Asteromphalus heptactis* (Brébisson) Ralfs ex Pritchard
*Rhizosolenia styliformis* Brightwell
*Chaetoceros dichaeta* Ehrenberg
*Chaetoceros compressum* Lauder
*Chaetoceros Ralfsi* Cleve
*Chuniella oceanica* (Karsten) Hendey

St. **1358**. 5. v. 34. 62° 36·4′ S, 30° 15·6′ E. 100–0 m.
Temp. −1·26° C. Salinity 33·86 $^{\circ}/_{\circ\circ}$. *p*H 8·24.

*Thalassiothrix longissima* Cleve et Grunow
*Rhizosolenia alata* Brightwell
*Rhizosolenia styliformis* Brightwell
*Dactyliosolen antarcticus* Castracane
*Corethron criophilum* Castracane
*Corethron criophilum* Castracane (spineless chains)
*Chaetoceros criophilum* Castracane
*Chaetoceros dichaeta* Ehrenberg
*Chaetoceros Ralfsi* Cleve
*Chuniella oceanica* (Karsten) Hendey
*Chaetoceros compressum* Lauder

St. **1359**. 6. v. 34. 63° 45·2′ S, 36° 41·1′ E. 100–0 m.
Temp. −1·37° C. Salinity 33·95 $^{\circ}/_{\circ\circ}$. *p*H 8·24.

*Thalassiothrix longissima* Cleve et Grunow
*Fragilariopsis antarctica* (Castracane) Hustedt
*Rhizosolenia alata* Brightwell
*Dactyliosolen antarcticus* Castracane
*Corethron criophilum* Castracane
*Chaetoceros criophilum* Castracane

*Asteromphalus heptactis* (Brébisson) Ralfs ex Pritchard
*Rhizosolenia styliformis* Brightwell
*Chaetoceros dichaeta* Ehrenberg
*Chaetoceros Ralfsi* Cleve
*Actinoptychus senarius* Ehrenberg

St. **1362**. 9. v. 34. 61° 45·5′ S, 44° 15·9′ E. 100–0 m.
Temp. −1·10° C. Salinity 33·88 $^{\circ}/_{\circ\circ}$. *p*H 8·15.

*Fragilariopsis antarctica* (Castracane) Hustedt
*Chaetoceros criophilum* Castracane
*Corethron criophilum* Castracane
*Dactyliosolen antarcticus* Castracane
*Rhizosolenia alata* Brightwell
*Asteromphalus Hookerii* Ehrenberg
*Chaetoceros dichaeta* Ehrenberg

St. **1369**. 17. v. 34. 42° 25·8′ S, 40° 22·6′ E. 100–0 m.
Temp. 8·72° C. Salinity 33·88 $^{\circ}/_{\circ\circ}$. *p*H 8·33.

*Fragilariopsis antarctica* (Castracane) Hustedt
*Rhizosolenia alata* Brightwell
*Rhizosolenia simplex* Karsten
*Corethron criophilum* Castracane
*Rhizosolenia curvata* Zacharias

St. **1373**. 21. v. 1934. 31° 13·1′ S, 31° 48·7′ E. 100–0 m.
Temp. 24·33° C. Salinity 35·29 $^{\circ}/_{\circ\circ}$. *p*H 8·42.

*Thalassiosira subtilis* (Ostenfeld) Gran
*Thalassiosira condensata* Cleve
*Chaetoceros messanense* Castracane
*Rhizosolenia Stolterfothii* H. Peragallo
*Schroderella delicatula* (Peragallo) Pavillard
*Schroderella Schroderi* (Bergon) Pavillard
*Thalassionema nitzschioides* Hustedt
*Chaetoceros decipiens* Cleve
*Stephanopyxis Palmeriana* (Greville) Grunow
*Planktoniella sol* (Wallich) Schütt
*Rhizosolenia styliformis* Brightwell
*Rhizosolenia Shrubsolii* Cleve
*Coscinodiscus concinnus* Wm. Smith
*Rhizosolenia alata* Brightwell
*Chaetoceros atlanticum* var. *neapolitana* (Schröder) Hustedt
*Lauderia borealis* Gran
*Chaetoceros coarctatum* Lauder
*Biddulphia mobiliensis* (Bailey) Grunow ex Van Heurck
*Asterionella japonica* (Cleve et Muller) Gran
*Chaetoceros danicum* Cleve
*Chaetoceros Glandazi* Mangin
*Gossleriella tropica* Schütt
*Biddulphia regia* (Schultze) Ostenfeld
*Rhizosolenia calcar-avis* Schultze
*Coscinodiscus gigas* Ehrenberg
*Hemiaulus Hauckii* Grunow ex Van Heurck
*Navicula membranacea* Cleve
*Asterionella notata* Grunow
*Eucampia zoodiacus* Ehrenberg
*Climacodium Frauenfeldianum* Grunow
*Coscinodiscus lineatus* Ehrenberg

St. **1376**. 2. viii. 34. 35° 51·9′ S, 13° 01·6′ E. 100–0 m.
Temp. 16·70° C. Salinity 35·75 $^{\circ}/_{\circ\circ}$.

*Planktoniella sol* (Wallich) Schütt
*Rhizosolenia alata* Brightwell

St. **1570**. 21. iv. 35. 28° 42·0′ S, 39° 06·6′ E. 100–0 m.
Temp. 25·18° C. Salinity 35·39 $^{\circ}/_{\circ\circ}$. *p*H 8·29.

*Climacodium Frauenfeldianum* Grunow
*Eucampia cornuta* (Cleve) Grunow ex Van Heurck
*Rhizosolenia Shrubsolii* Cleve
*Rhizosolenia styliformis* Brightwell
*Chaetoceros aequatoriale* Cleve

**St. 1572.** 22. iv. 35. 24° 59·7′ S, 39° 49·8′ E. 100–0 m.
Temp. 25·08° C. Salinity 35·42 °/$_{00}$. *p*H 8·30.

*Climacodium Frauenfeldianum* Grunow
*Eucampia cornuta* (Cleve) Grunow ex Van Heurck
*Planktoniella sol* (Wallich) Schütt
*Rhizosolenia styliformis* Brightwell
*Rhizosolenia robusta* Norman ex Pritchard
*Chaetoceros aequatoriale* Cleve
*Coscinodiscus radiatus* Ehrenberg

**St. 1574.** 23. iv. 35. 21° 44·6′ S, 40° 33·7′ E. 100–0 m.
Temp. 26·58° C. Salinity 35·31 °/$_{00}$. *p*H 8·29.

*Eucampia cornuta* (Cleve) Grunow ex Van Heurck
*Rhizosolenia styliformis* Brightwell
*Chaetoceros aequatoriale* Cleve
*Planktoniella sol* (Wallich) Schütt

**St. 1575.** 24. iv. 35. 18° 33·2′ S, 41° 35·4′ E. 100–0 m.
Temp. 27·38° C. Salinity 35·10 °/$_{00}$. *p*H 8·28.

*Planktoniella sol* (Wallich) Schütt
*Gossleriella tropica* Schütt
*Coscinodiscus lineatus* Ehrenberg
*Coscinodiscus concinnus* Wm. Smith
*Stephanopyxis Palmeriana* (Greville) Grunow
*Asterolampra marylandica* Ehrenberg
*Rhizosolenia robusta* Norman ex Pritchard

**St. 1581.** 28. iv. 35. 07° 42·1′ S, 44° 14·1′ E. 100–0 m.
Temp. 28·88° C. Salinity 34·88 °/$_{00}$. *p*H 8·28.

*Planktoniella sol* (Wallich) Schütt
*Eucampia cornuta* (Cleve) Grunow ex Van Heurck
*Rhizosolenia styliformis* Brightwell

**St. 1583.** 30. iv. 35. 04° 25·9′ S, 47° 10·0′ E. 100–0 m.
Temp. 29·53° C. Salinity 35·32 °/$_{00}$. *p*H 8·26.

*Coscinodiscus radiatus* Ehrenberg
*Chaetoceros atlanticum* var. *neapolitana* (Schröder) Hustedt
*Planktoniella sol* (Wallich) Schütt
*Bacteriastrum comosum* Pavillard
*Gossleriella tropica* Schütt

**St. 1584.** 1. v. 35. 00° 57·8′ S, 49° 26·7′ E. 100–0 m.
Temp. 29·68° C. Salinity 35·45 °/$_{00}$. *p*H 8·22.

*Rhizosolenia styliformis* Brightwell
*Planktoniella sol* (Wallich) Schütt
*Asterolampra Vanheurcki* Brun
*Climacodium Frauenfeldianum* Grunow
*Rhizosolenia alata* Brightwell
*Bacteriastrum comosum* Pavillard
*Eucampia cornuta* (Cleve) Grunow ex Van Heurck
*Chaetoceros atlanticum* var. *neapolitana* (Schröder) Hustedt
*Rhizosolenia polydactyla* Castracane
*Rhizosolenia alata* Brightwell
*Chaetoceros Ralfsi* Cleve
*Rhizosolenia robusta* Norman ex Pritchard
*Chaetoceros coarctatum* Lauder

**St. 1586.** 2. v. 35. 2° 39·4′ N, 50° 46·4′ E. 100–0 m.
Temp. 30·48° C. Salinity 35·37 °/$_{00}$. *p*H 8·18.

*Planktoniella sol* (Wallich) Schütt
*Rhizosolenia styliformis* Brightwell
*Bacteriastrum comosum* Pavillard
*Climacodium Frauenfeldianum* Grunow
*Rhizosolenia alata* Brightwell
*Gossleriella tropica* Schütt
*Eucampia cornuta* (Cleve) Grunow ex Van Heurck
*Chaetoceros Ralfsi* Cleve
*Chaetoceros atlanticum* var. *neapolitana* (Schröder) Hustedt
*Rhizosolenia polydactyla* Castracane
*Rhizosolenia robusta* Norman ex Pritchard
*Coscinodiscus marginatus* Ehrenberg

St. **1589**. 5. v. 35. 11° 32·3′ N, 52° 03·0′ E. 100–0 m.
Temp. 29·78° C. Salinity 35·50 °/$_{00}$. *p*H 8·26.

*Planktoniella sol* (Wallich) Schütt
*Rhizosolenia alata* Brightwell
*Rhizosolenia styliformis* Brightwell

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St. **WS 100**. 23. iv. 27. 50° 53′ S, 61° 26′ W. 100–0 m.
Temp. 7·78° C. Salinity 33·79 °/$_{00}$. $P_2O_5$ 78.

*Chaetoceros sociale* Lauder
*Chaetoceros convolutum* Castracane
*Chaetoceros debile* Cleve
*Rhizosolenia alata* Brightwell
*Chaetoceros peruvianum* Brightwell
*Actinoptychus senarius* Ehrenberg
*Corethron criophilum* Castracane
*Chaetoceros neglectum* Karsten
*Coscinodiscus sub-bulliens* Jörgensen
*Rhizosolenia styliformis* Brightwell

St. **WS 101**. 23. iv. 27. 50° 27′ S, 62° 06′ W. 100–0 m.
Temp. 8·20° C. Salinity 33·66 °/$_{00}$. $P_2O_5$ 70.

*Actinoptychus senarius* Ehrenberg
*Rhizosolenia alata* Brightwell
*Chaetoceros sociale* Lauder
*Chaetoceros criophilum* Castracane
*Melosira sol* (Ehrenberg) Kützing
*Corethron criophilum* Castracane

St. **WS 103**. 23. iv. 27. 49° 40′ S, 63° 13′ W. 100–0 m.
Temp. 8·49° C. Salinity 33·67 °/$_{00}$. $P_2O_5$ 70.

*Actinoptychus senarius* Ehrenberg

St. **WS 104**. 24. iv. 27. 49° 18′ S, 63° 40′ W. 100–0 m.
Temp. 8·24° C. Salinity 33·57 °/$_{00}$. $P_2O_5$ 76.

*Rhizosolenia styliformis* Brightwell
*Chaetoceros criophilum* Castracane
*Chaetoceros Chunii* Karsten
*Actinoptychus senarius* Ehrenberg

St. **WS 105**. 24. iv. 27. 48° 50′ S, 64° 24′ W. 100–0 m.
Temp. 8·88° C. Salinity 33·49 °/$_{00}$. $P_2O_5$ 75.

*Actinoptychus senarius* Ehrenberg
*Ditylum Brightwellii* (West) Grunow
*Rhizosolenia alata* Brightwell

St. **WS 106**. 24. iv. 27. 48° 25′ S, 65° 00′ W. 100–0 m.
Temp. 9·88° C. Salinity 33·22 °/$_{00}$. $P_2O_5$ 68.

*Rhizosolenia alata* Brightwell
*Corethron criophilum* Castracane
*Actinoptychus senarius* Ehrenberg

St. **WS 107**. 25. iv. 27. 48° 00′ S, 65° 29′ W. 100–0 m.
Temp. 10·55° C. Salinity 33·06 °/$_{00}$. $P_2O_5$ 70.

*Actinoptychus senarius* Ehrenberg
*Ditylum Brightwellii* (West) Grunow
*Rhizosolenia hebetata* Bailey
*Rhizosolenia alata* Brightwell

St. **WS 469**. 10. xi. 29. 56° 42′ S, 57° 00′ W. 100–0 m.
Temp. 3·49° C. Salinity 34·10 °/$_{00}$.

*Rhizosolenia alata* Brightwell
*Corethron criophilum* Castracane
*Thalassiosira antarctica* Comber
*Fragilariopsis antarctica* (Castracane) Hustedt
*Rhizosolenia styliformis* Brightwell
*Chaetoceros dichaeta* Ehrenberg
*Dactyliosolen antarcticus* Castracane
*Biddulphia striata* Karsten
*Nitzschia seriata* Cleve
*Rhizosolenia crassa* Karsten
*Rhizosolenia polydactyla* Castracane
*Eucampia balaustium* Castracane

St. **WS 474.** 13. xi. 29. 61° 03′ S, 56° 42′ W. 100–0 m.
Temp. −0·50° C. Salinity 34·01 °/oo.

*Rhizosolenia alata* Brightwell
*Corethron criophilum* Castracane
*Chaetoceros criophilum* Castracane
*Thalassiosira antarctica* Comber
*Biddulphia striata* Karsten
*Fragilariopsis antarctica* (Castracane) Hustedt
*Rhizosolenia styliformis* Brightwell
*Nitzschia seriata* Cleve
*Eucampia balaustium* Castracane

St. **WS 481.** 16. xi. 29. 62° 59′ S, 57° 28′ W. 200–0 m.
Temp. −1·18° C. Salinity 34·47 °/oo.

*Corethron criophilum* Castracane
*Thalassiosira antarctica* Comber
*Rhizosolenia alata* Brightwell
*Fragilariopsis antarctica* (Castracane) Hustedt
*Melosira sol* (Ehrenberg) Kützing
*Eucampia balaustium* Castracane
*Coscinodiscus bouvet* Karsten
*Charcotia bifrons* (Castracane) Peragallo
*Thalassiothrix acuta* Karsten
*Biddulphia punctata* Greville
*Coscinodiscus sub-bulliens* Jörgensen
*Synedra auriculata* Karsten
*Trigonium arcticum* (Brightwell) Cleve
*Biddulphia striata* Karsten
*Arachnoidiscus Ehrenbergii* Bailey ex Ehrenberg
*Stictodiscus affinis* Castracane
*Asteromphalus Hookerii* Ehrenberg
*Coscinodiscus radiatus* Ehrenberg
*Coscinodiscus stellaris* Roper
*Melosira polaris* Grunow
*Trachyneis aspera* (Ehrenberg) Cleve
*Charcotia janus* var. *planus* Peragallo
*Cocconeis imperatrix* Schmidt
*Cocconeis antiqua* Tempere et Brun
*Licmophora luxuriosa* Heiden et Kolbe
*Anaulus scalaris* Ehrenberg
*Anaulus ellipticus* Hendey
*Entopyla kerguelensis* Karsten
*Cocconeis pinnata* Gregory ex Greville
*Navicula astrolabensis* Hendey
*Coscinodiscus kerguelensis* Karsten
*Grammatophora serpentina* Ehrenberg
*Grammatophora kerguelensis* Karsten
*Actinocyclus octonarius* Ehrenberg
*Biddulphia polymorpha* (Grunow) Wolle
*Biddulphia aurita*, var. *obtusa* (Kützing) Hustedt
*Achnanthes kerguelensis* Castracane
*Biddulphia astrolabensis* Hendey
*Navicula Schuettii* Van Heurck
*Amphora Peragallorum* Van Heurck
*Pleurosigma Smithianum* Castracane
*Scoresbya Kempii* Hendey

St. **WS 540.** 27/28. i. 31. 57° 55′ S, 21° 21′ W. 100–0 m.
Temp. −0·30° C. Salinity 33·17 °/oo.

*Chaetoceros criophilum* Castracane
*Corethron criophilum* Castracane
*Rhizosolenia hebetata* Bailey
*Rhizosolenia alata* Brightwell

St. **WS 541.** 28. i. 31. 57° 51½′ S, 19° 51½′ W. 100–0 m.
Temp. 0·68° C. Salinity 33·35 °/oo.

*Rhizosolenia hebetata* Bailey
*Chaetoceros criophilum* Castracane
*Corethron criophilum* Castracane
*Fragilariopsis antarctica* (Castracane) Hustedt
*Rhizosolenia alata* Brightwell

St. **WS 542.** 28. i. 31. 58° 39′ S, 18° 13′ W. 100–0 m.
Temp. −0·09° C. Salinity 33·40 °/oo.

*Rhizosolenia hebetata* Bailey
*Nitzschia seriata* Cleve
*Corethron criophilum* Castracane
*Rhizosolenia bidens* Karsten
*Nitzschia closterium* (Ehrenberg) Wm. Smith
*Fragilariopsis antarctica* (Castracane) Hustedt
*Rhizosolenia crassa* Karsten

St. **WS 543**. 29. i. 31. 60° 10½′ S, 18° 00′ W. 100–0 m.
Temp. −0·45° C. Salinity 33·45 $^{\circ}/_{00}$.

*Rhizosolenia hebetata* Bailey
*Corethron criophilum* Castracane
*Nitzschia seriata* Cleve
*Fragilariopsis antarctica* (Castracane) Hustedt
*Rhizosolenia bidens* Karsten
*Nitzschia closterium* (Ehrenberg) Wm. Smith

St. **WS 545**. 30. i. 31. 61° 51′ S, 17° 15′ W. 100–0 m.
Temp. −0·92° C. Salinity 34·07 $^{\circ}/_{00}$.

*Rhizosolenia hebetata* Bailey
*Chaetoceros criophilum* Castracane
*Corethron criophilum* Castracane
*Thalassiosira antarctica* Comber
*Fragilariopsis antarctica* (Castracane) Hustedt
*Nitzschia seriata* Cleve
*Rhizosolenia alata* Brightwell
*Chaetoceros dichaeta* Ehrenberg
*Chaetoceros Chunii* Karsten
*Asteromphalus Hookerii* Ehrenberg
*Coscinodiscus lentiginosus* Janisch
*Dactyliosolen antarcticus* Castracane

St. **WS 547**. 30. i. 31. 62° 40′ S, 17° 02′ W. 100–0 m.
Temp. −0·85° C. Salinity 33·96 $^{\circ}/_{00}$.

*Rhizosolenia hebetata* Bailey
*Chaetoceros criophilum* Castracane
*Corethron criophilum* Castracane
*Fragilariopsis antarctica* (Castracane) Hustedt
*Nitzschia seriata* Cleve
*Rhizosolenia alata* Brightwell

St. **WS 548**. 31. i. 31. 64° 07′ S, 15° 38′ W. 100–0 m.
Temp. −0·58° C. Salinity 34·06 $^{\circ}/_{00}$.

*Corethron criophilum* Castracane
*Fragilariopsis antarctica* (Castracane) Hustedt
*Chaetoceros criophilum* Castracane
*Rhizosolenia alata* Brightwell
*Rhizosolenia hebetata* Bailey
*Chaetoceros neglectum* Karsten
*Nitzschia seriata* Cleve
*Chaetoceros dichaeta* Ehrenberg
*Coscinodiscus lentiginosus* Janisch
*Dactyliosolen antarcticus* Castracane
*Actinocyclus intermittens* Karsten

St. **WS 549**. 31. i. 31. 65° 17′ S, 15° 33′ W. 100–0 m.
Temp. −0·50° C. Salinity 34·14 $^{\circ}/_{00}$.

*Corethron criophilum* Castracane
*Rhizosolenia alata* Brightwell
*Rhizosolenia hebetata* Bailey
*Chaetoceros criophilum* Castracane
*Chaetoceros neglectum* Karsten
*Nitzschia seriata* Cleve
*Fragilariopsis antarctica* (Castracane) Hustedt
*Asteromphalus Hookerii* Ehrenberg
*Dactyliosolen antarcticus* Castracane
*Coscinodiscus lentiginosus* Janisch
*Chaetoceros dichaeta* Ehrenberg
*Actinocyclus intermittens* Karsten

St. **WS 550**. 1. ii. 31. 66° 51½′ S, 15° 24′ W. 100–0 m.
Temp. −0·23° C. Salinity 34·06 $^{\circ}/_{00}$.

*Chaetoceros neglectum* Karsten
*Corethron criophilum* Castracane
*Chaetoceros dichaeta* Ehrenberg
*Dactyliosolen antarcticus* Castracane
*Fragilariopsis antarctica* (Castracane) Hustedt
*Rhizosolenia alata* Brightwell
*Chaetoceros criophilum* Castracane
*Chaetoceros atlanticum* var. *neapolitana* (Schröder) Hustedt
*Rhizosolenia hebetata* Bailey
*Chaetoceros Schimperianum* Karsten
*Coscinodiscus lentiginosus* Janisch
*Asteromphalus Hookerii* Ehrenberg
*Eucampia balaustium* Castracane
*Nitzschia pelagica* Karsten
*Actinocyclus intermittens* Karsten
*Asteromphalus heptactis* (Brébisson) Ralfs ex Pritchard

St. **WS 551**. 1. ii. 31. 68° 17½′ S, 14° 26½′ W. 100–0 m.
Temp. −1·27° C. Salinity 33·91 ‰.

*Chaetoceros neglectum* Karsten
*Corethron criophilum* Castracane
*Chaetoceros dichaeta* Ehrenberg
*Rhizosolenia alata* Brightwell
*Fragilariopsis antarctica* (Castracane) Hustedt
*Dactyliosolen antarcticus* Castracane
*Rhizosolenia alata* Brightwell
*Coscinodiscus lentiginosus* Janisch
*Rhizosolenia hebetata* Brightwell
*Chaetoceros criophilum* Castracane
*Chaetoceros Schimperianum* Karsten
*Asteromphalus Hookerii* Ehrenberg
*Eucampia balaustium* Castracane
*Rhizosolenia styliformis* Brightwell

St. **WS 552** A. 2. ii. 31. 68° 51½′ S, 13° 03′ W. 100–0 m.
Temp. −0·90° C. Salinity 33·91 ‰.

*Chaetoceros neglectum* Karsten
*Corethron criophilum* Castracane
*Chaetoceros dichaeta* Ehrenberg
*Fragilariopsis antarctica* (Castracane) Hustedt
*Rhizosolenia alata* Brightwell
*Dactyliosolen antarcticus* Castracane
*Coscinodiscus lentiginosus* Janisch
*Chaetoceros criophilum* Castracane
*Rhizosolenia hebetata* Bailey
*Chaetoceros Schimperianum* Karsten
*Asteromphalus Hookerii* Ehrenberg
*Eucampia balaustium* Castracane

St. **WS 569**. 6. iii. 31. 53° 24½′ S, 37° 29¼′ W. 100–0 m.
Temp. 2·53° C. Salinity 33·76 ‰.

*Corethron criophilum* Castracane
*Chaetoceros criophilum* Castracane
*Rhizosolenia styliformis* Brightwell

St. **WS 571**. 19. iii. 31. 2¾ miles S 52° E from Jason light, Cumberland Bay, South Georgia. 100–0 m.
Temp. 2·30° C. Salinity 33·68 ‰.

*Corethron criophilum* Castracane
*Chaetoceros criophilum* Castracane

St. **WS 580**. 23. iv. 31. 53° 04′ 45″ S, 70° 40′ 40″ W. 90–0 m.
Temp. 8·36° C.

*Chaetoceros sociale* Lauder
*Chaetoceros neglectum* Karsten
*Thalassiosira antarctica* Comber
*Chaetoceros criophilum* Castracane
*Chaetoceros Lorenzianum* Grunow
*Actinoptychus senarius* Ehrenberg
*Thalassionema nitzschioides* Hustedt

St. **WS 593**. 18. v. 31. 35° 36′ S, 72° 44′ W. 40–0 m.
Temp. 11·45° C. Salinity 34·11 ‰.

*Stephanopyxis turris* (Greville) Ralfs ex Pritchard
*Corethron criophilum* Castracane
*Skeletonema costatum* (Greville) Cleve
*Nitzschia seriata* Cleve
*Chaetoceros criophilum* Castracane
*Chaetoceros peruvianum* Brightwell
*Thalassiosira decipiens* (Grunow) Jörgensen
*Biddulphia longicruris* Greville
*Rhizosolenia delicatula* Cleve
*Schroderella Schroderi* (Bergon) Pavillard
*Rhizosolenia Chunii* Karsten

St. **WS 594**. 18. v. 31. 35° 36′ S, 72° 50′ W. 40–0 m.
Temp. 11·69° C. Salinity 34·43 ‰.

*Corethron criophilum* Castracane
*Chaetoceros criophilum* Castracane
*Chaetoceros Lorenzianum* Grunow
*Stephanopyxis turris* (Greville) Ralfs ex Pritchard
*Rhizosolenia Chunii* Karsten
*Skeletonema costatum* (Greville) Cleve
*Biddulphia longicruris* Greville
*Chaetoceros peruvianum* Brightwell
*Schroderella Schroderi* (Bergon) Pavillard

St. **WS 598**. 19. v. 31. 35° 43′ S, 73° 32′ W. 100–0 m.
Temp. 12·12° C. Salinity 34·22 ‰.

*Corethron criophilum* Castracane
*Chaetoceros criophilum* Castracane
*Chaetoceros peruvianum* Brightwell
*Skeletonema costatum* (Greville) Cleve
*Thalassiothrix longissima* Cleve et Grunow
*Thalassiothrix antarctica* Karsten
*Chaetoceros neglectum* Karsten
*Biddulphia longicruris* Greville
*Rhizosolenia alata* Brightwell
*Rhizosolenia hebetata* Bailey

St. **WS 600**. 19. v. 31. 35° 40′ S, 73° 55′ W. 100–0 m.
Temp. 13·57° C. Salinity 33·97 ‰.

*Chaetoceros neglectum* Karsten
*Corethron criophilum* Castracane
*Thalassiothrix antarctica* Karsten
*Chaetoceros criophilum* Castracane
*Chaetoceros peruvianum* Brightwell
*Rhizosolenia alata* Brightwell
*Skeletonema costatum* (Greville) Cleve

St. **WS 601**. 20. v. 31. 35° 30′ 30″ S, 74° 18′ W. 100–0 m.
Temp. 13·65° C. Salinity 33·87 ‰.

*Thalassiothrix antarctica* Karsten
*Corethron criophilum* Castracane
*Chaetoceros peruvianum* Brightwell
*Rhizosolenia styliformis* Brightwell
*Skeletonema costatum* (Greville) Cleve
*Rhizosolenia alata* Brightwell
*Nitzschia seriata* Cleve

St. **WS 602**. 28. v. 31. 32° 04′ 45″ S, 71° 34′ W. 50–0 m.
Temp. 14·02° C. Salinity 34·24 ‰. *p*H 8·25.

*Thalassiothrix antarctica* Karsten
*Corethron criophilum* Castracane
*Chaetoceros criophilum* Castracane
*Nitzschia seriata* Cleve
*Skeletonema costatum* (Greville) Cleve
*Biddulphia longicruris* Greville

St. **WS 621**. 7. vi. 31. 24° 27′ 30″ S, 70° 43′ W. 100–0 m.
Temp. 17·20° C. Salinity 34·79 ‰.

*Corethron criophilum* Castracane
*Bacteriastrum delicatulum* Cleve
*Planktoniella sol* (Wallich) Schütt
*Rhizosolenia alata* Brightwell

St. **WS 622**. 8. vi. 31. 23° 32′ 36″ S, 70° 38′ 30″ W. 100–0 m.
Temp. 14·10° C. Salinity 34·59 ‰.

*Corethron criophilum* Castracane
*Planktoniella sol* (Wallich) Schütt
*Actinoptychus senarius* Ehrenberg
*Rhabdonema adriaticum* Kützing
*Navicula lyra* (Ehrenberg) Kützing
*Biddulphia longicruris* Greville
*Biddulphia antediluviana* (Ehrenberg) Van Heurck
*Coscinodiscus Asteromphalus* Ehrenberg
*Trigonium arcticum* (Brightwell) Cleve

St. **WS 623**. 8. vi. 31. 23° 32′ 42″ S, 70° 41′ W. 100–0 m.
Temp. 14·14° C. Salinity 34·64 ‰.

*Corethron criophilum* Castracane
*Rhabdonema adriaticum* Kützing
*Trigonium arcticum* (Brightwell) Cleve
*Planktoniella sol* (Wallich) Schütt
*Coscinodiscus Asteromphalus* Ehrenberg

St. **WS 629**. 9. vi. 31. 23° 21′ 30″ S, 71° 28′ W. 100–0 m.
Temp. 18·04° C. Salinity 34·87 ‰.

*Planktoniella sol* (Wallich) Schütt
*Rhizosolenia alata* Brightwell
*Biddulphia antediluviana* (Ehrenberg) Van Heurck
*Chaetoceros Lorenzianum* Grunow

St. **WS 630**. 9. vi. 31. 23° 22′ S, 71° 06′ W. 100–0 m.
Temp. 17·31° C. Salinity 34·70 ‰.

*Planktoniella sol* (Wallich) Schütt
*Chaetoceros messanense* Castracane
*Rhizosolenia alata* Brightwell
*Rhizosolenia simplex* Karsten
*Gossleriella tropica* Schütt
*Fragilaria granulata* Karsten

St. **WS 631**. 10. vi. 31. 23° 12′ S, 70° 49′ W. 120–0 m.
Temp. 16·50° C. Salinity 34·64 ‰.

*Planktoniella sol* (Wallich) Schütt
*Chaetoceros messanense* Castracane
*Fragilaria granulata* Karsten
*Gossleriella tropica* Schütt
*Rhizosolenia alata* Brightwell
*Corethron criophilum* Castracane
*Asteromphalus Hookerii* Ehrenberg

St. **WS 640**. 19. vi. 31. 18° 28′ S, 70° 23′ 36″ W. 70–0 m.
Temp. 16·57° C. Salinity 34·70 ‰.

*Chaetoceros Lorenzianum* Grunow
*Planktoniella sol* (Wallich) Schütt
*Schroderella Schroderi* (Bergon) Pavillard
*Corethron criophilum* Castracane

St. **WS 641**. 19. vi. 31. 18° 27′ 30″ S, 70° 26′ 30″ W. 100–0 m.
Temp. 17·62° C. Salinity 34·85 ‰.

*Chaetoceros Lorenzianum* Grunow
*Planktoniella sol* (Wallich) Schütt
*Actinoptychus senarius* Ehrenberg
*Chaetoceros messanense* Castracane
*Coscinodiscus radiatus* Ehrenberg
*Rhizosolenia hebetata* Bailey

St. **WS 642**. 19. vi. 31. 18° 28′ 24″ S, 70° 32′ 12″ W. 100–0 m.
Temp. 17·91° C. Salinity 35·04 ‰.

*Planktoniella sol* (Wallich) Schütt
*Chaetoceros Lorenzianum* Grunow

St. **WS 643**. 19. vi. 31. 18° 30′ S, 70° 42′ 48″ W. 100–0 m.
Temp. 18·12° C. Salinity 34·95 ‰.

*Planktoniella sol* (Wallich) Schütt
*Rhizosolenia hebetata* Bailey

St. **WS 644**. 20. vi. 31. 16° 55′ 12″ S, 72° 39′ W. 100–0 m.
Temp. 16·43° C. Salinity 34·90 ‰.

*Planktoniella sol* (Wallich) Schütt
*Asteromphalus heptactis* (Brébisson) Ralfs ex Pritchard
*Skeletonema costatum* (Greville) Cleve
*Coscinodiscus Asteromphalus* Ehrenberg
*Corethron criophilum* Castracane

St. **WS 645**. 21. vi. 31. 15° 42′ 18″ S, 75° 03′ W. 100–0 m.
Temp. 14·85° C. Salinity 34·90 ‰.

*Thalassiosira subtilis* (Ostenfeld) Gran
*Rhizosolenia styliformis* Brightwell
*Coscinodiscus Asteromphalus* Ehrenberg
*Planktoniella sol* (Wallich) Schütt

St. **WS 646**. 22. vi. 31. 15° 35′ S, 75° 41′ W. 100–0 m.
Temp. 14·81° C. Salinity 34·97 ‰.

*Chaetoceros Lorenzianum* Grunow
*Thalassionema Nitzschioides* Hustedt
*Thalassiothrix acuta* Karsten
*Coscinodiscus radiatus* Ehrenberg

St. **WS 647**. 22. vi. 31. 15° 19′ 12″ S, 75° 11′ 30″ W. 50–0 m.
Temp. 13·79° C. Salinity 34·88 °/$_{00}$.

*Chaetoceros Lorenzianum* Grunow
*Thalassiosira decipiens* (Grunow) Jörgensen
*Stephanopyxis turris* (Greville) Ralfs ex Pritchard
*Coscinodiscus centralis* Ehrenberg
*Rhizosolenia Shrubsolii* Cleve
*Coscinodiscus gigas* Ehrenberg
*Coscinodiscus radiatus* Ehrenberg
*Actinoptychus senarius* Ehrenberg
*Skeletonema costatum* (Greville) Cleve
*Chaetoceros sociale* Lauder

St. **WS 648**. 22. vi. 31. 15° 19′ 30″ S, 75° 13′ W. 100–0 m.
Temp. 13·82° C. Salinity 34·87 °/$_{00}$.

*Chaetoceros Lorenzianum* Grunow
*Thalassiosira decipiens* (Grunow) Jörgensen
*Coscinodiscus radiatus* Ehrenberg
*Actinoptychus senarius* Ehrenberg

St. **WS 649**. 22. vi. 31. 15° 20′ S, 75° 16′ 30″ W. 100–0 m.
Temp. 14·19° C. Salinity 35·00 °/$_{00}$.

*Chaetoceros Lorenzianum* Grunow
*Thalassiosira decipiens* (Grunow) Jörgensen
*Coscinodiscus radiatus* Ehrenberg
*Skeletonema costatum* (Greville) Cleve
*Actinoptychus senarius* Ehrenberg

St. **WS 650**. 22. vi. 31. 15° 22′ 30″ S, 75° 22′ W. 100–0 m.
Temp. 14·43° C. Salinity 34·99 °/$_{00}$.

*Chaetoceros Lorenzianum* Grunow
*Thalassiosira decipiens* (Grunow) Jörgensen
*Actinoptychus senarius* Ehrenberg
*Stephanopyxis turris* (Greville) Ralfs ex Pritchard

St. **WS 665**. 1. vii. 31. 12° 13′ 18″ S, 77° 21′ 48″ W. 100–0 m.
Temp. 17·55° C. Salinity 35·20 °/$_{00}$.

*Schroderella Schroderi* (Bergon) Pavillard

St. **WS 666**. 1. vii. 31. 12° 18′ 30″ S, 77° 30′ 30″ W. 100–0 m.
Temp. 17·84° C. Salinity 35·25 °/$_{00}$.

*Schroderella Schroderi* (Bergon) Pavillard
*Synedra pelagica* Hendey
*Rhizosolenia alata* Brightwell
*Coscinodiscus Asteromphalus* Ehrenberg
*Planktoniella sol* (Wallich) Schütt
*Chaetoceros peruvianum* Brightwell

St. **WS 700**. 21. vii. 31. 05° 52′ S, 81° 15′ 30″ W. 100–0 m.
Temp. 18·26° C. Salinity 35·13 °/$_{00}$.

*Chaetoceros decipiens* Cleve
*Chaetoceros didymum* Ehrenberg
*Coscinodiscus radiatus* Ehrenberg
*Rhizosolenia hebetata* Bailey
*Rhizosolenia Shrubsolii* Cleve
*Nitzschia seriata* Cleve
*Asterionella japonica* Gran
*Rhizosolenia styliformis* Brightwell
*Chaetoceros sociale* Lauder
*Rhizosolenia robusta* Norman ex Pritchard

St. **WS 701**. 21. vii. 31. 05° 48′ S, 81° 22′ 30″ W. 100–0 m.
Temp. 18·49° C. Salinity 35·11 °/$_{00}$.

*Rhizosolenia hebetata* Bailey
*Coscinodiscus radiatus* Ehrenberg
*Chaetoceros decipiens* Cleve
*Nitzschia seriata* Cleve
*Rhizosolenia styliformis* Brightwell
*Rhizosolenia robusta* Norman ex Pritchard

St. **WS 703**. 22. vii. 31. 05° 34′ S, 82° 11′ 30″ W. 100–0 m.
Temp. 18·18° C. Salinity 35·12 ‰.

*Rhizosolenia hebetata* Bailey
*Rhizosolenia robusta* Norman ex Pritchard
*Chaetoceros decipiens* Cleve
*Rhizosolenia alata* Brightwell
*Chaetoceros peruvianum* Brightwell
*Coscinodiscus radiatus* Ehrenberg
*Rhizosolenia Shrubsolii* Cleve
*Asterionella japonica* Gran
*Rhizosolenia styliformis* Brightwell
*Corethron criophilum* Castracane
*Nitzschia seriata* Cleve
*Thalassiosira condensata* Cleve

St. **WS 704**. 22. vii. 31. 05° 33′ S, 82° 47′ W. 100–0 m.
Temp. 19·01° C. Salinity 35·12 ‰.

*Rhizosolenia hebetata* Bailey
*Chaetoceros decipiens* Cleve
*Rhizosolenia styliformis* Brightwell
*Rhizosolenia Shrubsolii* Cleve
*Rhizosolenia robusta* Norman ex Pritchard

St. **WS 705**. 23. vii. 31. 05° 33′ 30″ S, 83° 41′ 45″ W. 100–0 m.
Temp. 19·03° C. Salinity 35·11 ‰.

*Rhizosolenia hebetata* Bailey
*Rhizosolenia alata* Brightwell
*Thalassiosira condensata* Cleve
*Chaetoceros decipiens* Cleve
*Schroderella Schroderi* (Bergon) Pavillard
*Thalassiosira subtilis* (Ostenfeld) Gran
*Skeletonema costatum* (Greville) Cleve
*Hemidiscus cuneiformis* Wallich
*Asteromphalus heptactis* (Brébisson) Ralfs ex Pritchard
*Planktoniella sol* (Wallich) Schütt
*Nitzschia seriata* Cleve
*Corethron criophilum* Castracane

St. **WS 706**. 23. vii. 31. 05° 37′ 30″ S, 83° 58′ W. 100–0 m.
Temp. 19·74° C. Salinity 35·16 ‰.

*Rhizosolenia hebetata* Bailey
*Chaetoceros decipiens* Cleve
*Chaetoceros peruvianum* Brightwell
*Thalassiosira subtilis* (Ostenfeld) Gran
*Rhizosolenia simplex* Karsten
*Asteromphalus heptactis* (Brébisson) Ralfs ex Pritchard
*Rhizosolenia alata* Brightwell
*Planktoniella sol* (Wallich) Schütt
*Fragilaria granulata* Karsten
*Rhizosolenia robusta* Norman ex Pritchard
*Nitzschia seriata* Cleve
*Corethron criophilum* Castracane
*Bacteriastrum varians* Lauder

St. **WS 707**. 23. vii. 31. 05° 37′ 30″ S, 84° 31′ 30″ W. 100–0 m.
Temp. 20·69° C. Salinity 35·16 ‰.

*Rhizosolenia hebetata* Bailey
*Rhizosolenia alata* Brightwell
*Planktoniella sol* (Wallich) Schütt
*Asteromphalus heptactis* (Brébisson) Ralfs ex Pritchard
*Fragilaria granulata* Karsten
*Chaetoceros atlanticum* Cleve

St. **WS 708**. 24. vii. 31. 04° 18′ S, 82° 05′ W. 100–0 m.
Temp. 18·52° C. Salinity 34·81 ‰.

*Licmophora Lyngbyei* (Kützing) Grunow
*Rhizosolenia hebetata* Bailey
*Rhizosolenia alata* Brightwell

St. **WS 709**. 25. vii. 31. 04° 17′ S, 81° 16′ 45″ W. 15–0 m.
Temp. 22·63° C. Salinity 34·15 °/oo.

*Stephanopyxis turris* (Greville) Ralfs ex Pritchard
*Rhizosolenia alata* Brightwell
*Rhizosolenia styliformis* Brightwell
*Chaetoceros Lorenzianum* Grunow
*Nitzschia seriata* Cleve
*Bacteriastrum hyalinum* var. *princeps* (Castracane) Ikari
*Lauderia punctata* Karsten
*Skeletonema costatum* (Greville) Cleve
*Chaetoceros peruvianum* Brightwell
*Schroderella Schroderi* (Bergon) Pavillard
*Eucampia balaustium* Castracane
*Chaetoceros didymum* Ehrenberg
*Rhizosolenia polydactyla* Castracane
*Rhizosolenia Stolterfothii* H. Peragallo
*Streptotheca thamesis* Shrubsole
*Rhizosolenia calcar-avis* Schultze
*Coscinodiscus gigas* Ehrenberg
*Bacteriastrum delicatulum* Cleve
*Thalassionema nitzschioides* Hustedt
*Chaetoceros coarctatum* Lauder

St. **WS 709**. 25. vii. 31. 04° 17′ S, 81° 16′ 45″ W. 30–15 m.
Temp. 22·63° C. Salinity 34·15 °/oo.

*Thalassiosira subtilis* (Ostenfeld) Gran
*Nitzschia seriata* Cleve
*Rhizosolenia alata* Brightwell
*Coscinodiscus gigas* Ehrenberg
*Asteromphalus heptactis* (Brébisson) Ralfs ex Pritchard
*Rhizosolenia robusta* Norman ex Pritchard
*Thalassionema nitzschioides* Hustedt
*Rhizosolenia styliformis* Brightwell

St. **WS 710**. 25. vii. 31. 04° 18′ S, 81° 20′ 15″ W. 15–0 m.
Temp. 21·54° C. Salinity 34·44 °/oo.

*Rhizosolenia styliformis* Brightwell
*Rhizosolenia alata* Brightwell
*Bacteriastrum hyalinum* var. *princeps* (Castracane) Ikari
*Lauderia punctata* Karsten
*Thalassiosira subtilis* (Ostenfeld) Gran
*Skeletonema costatum* (Greville) Cleve
*Thalassionema nitzschiodes* Hustedt
*Eucampia balaustium* Castracane
*Chaetoceros Lorenzianum* Grunow
*Coscinodiscus gigas* Ehrenberg
*Ditylum Brightwellii* (West) Grunow ex Van Heurck
*Chaetoceros coarctatum* Lauder
*Stephanopyxis turris* (Greville) Ralfs ex Pritchard
*Rhizosolenia calcar-avis* Schultze
*Streptotheca thamesis* Shrubsole
*Chaetoceros didymum* Ehrenberg
*Rhizosolenia alata* Brightwell
*Rhizosolenia polydactyla* Castracane
*Rhizosolenia Stolterfothii* H. Peragallo
*Schroderella Schroderi* (Bergon) Pavillard
*Corethron criophilum* Castracane
*Leptocylindrus danicus* Cleve
*Chaetoceros Ralfsi* Cleve

St. **WS 710**. 25. vii. 31. 04° 18′ S, 81° 20′ 15″ W. 60–15 m.
Temp. 21·54° C. Salinity 34·44 °/oo.

*Rhizosolenia alata* Brightwell
*Chaetoceros Lorenzianum* Grunow
*Thalassionema nitzschioides* Hustedt
*Nitzschia seriata* Cleve
*Thalassiosira subtilis* (Ostenfeld) Gran
*Streptotheca thamesis* Shrubsole
*Coscinodiscus gigas* Ehrenberg
*Rhizosolenia hebetata* Bailey
*Lauderia punctata* Karsten
*Rhizosolenia styliformis* Brightwell

St. **WS 711**. 25. vii. 31. 04° 19′ 30″ S, 81° 27′ W. 100–0 m.
Temp. 21·19° C. Salinity 34·53 °/oo.

*Schroderella Schroderi* (Bergon) Pavillard
*Rhizosolenia alata* Brightwell
*Rhizosolenia styliformis* Brightwell
*Thalassiosira subtilis* (Ostenfeld) Gran

St. **WS 712**. 25. vii. 31. 04° 20′ S, 81° 37′ 45″ W. 100–0 m.
Temp. 20·44° C. Salinity 34·68 ‰.

*Stephanopyxis turris* (Greville) Ralfs ex Pritchard
*Thalassiosira subtilis* (Ostenfeld) Gran
*Rhizosolenia alata* Brightwell

St. **WS 713**. 25. vii. 31. 04° 20′ S, 81° 47′ W. 100–0 m.
Temp. 16·84° C. Salinity 35·22 ‰.

*Thalassiosira subtilis* (Ostenfeld) Gran
*Thalassionema nitzschioides* Hustedt

St. **WS 714**. 26. vii. 31. 04° 20′ S, 81° 57′ 30″ W. 100–0 m.
Temp. 17·00° C. Salinity 35·02 ‰.

*Chaetoceros coarctatum* Lauder
*Rhizosolenia alata* Brightwell
*Chaetoceros Lorenzianum* Grunow
*Chaetoceros didymum* Ehrenberg
*Lauderia punctata* Karsten
*Thalassiosira subtilis* (Ostenfeld) Gran
*Rhizosolenia hebetata* Bailey

St. **WS 715**. 31. vii. 31. 02° 11′ 15″ S, 81° 04′ W. 50–0 m.
Temp. 24·30° C. Salinity 33·76 ‰.

*Planktoniella sol* (Wallich) Schütt
*Lauderia punctata* Karsten
*Chaetoceros didymum* Ehrenberg
*Rhizosolenia alata* Brightwell
*Chaetoceros peruvianum* Brightwell
*Rhizosolenia hebetata* Bailey

St. **WS 716**. 31. vii. 31. 02° 11′ S, 81° 09′ W. 50–0 m.
Temp. 24·43° C. Salinity 33·79 ‰.

*Chaetoceros Lorenzianum* Grunow
*Rhizosolenia hebetata* Bailey
*Chaetoceros peruvianum* Brightwell
*Planktoniella sol* (Wallich) Schütt

## S.S. 'C. A. LARSEN'

St. **RS 9**. 18. xii. 28. 70° 02′ S, 180° 10′ W. 100–0 m.
Temp. −1·60° C. Salinity 33·98 ‰.

*Corethron criophilum* Castracane
*Chaetoceros criophilum* Castracane
*Rhizosolenia alata* Brightwell
*Fragilariopsis antarctica* (Castracane) Hustedt
*Rhizosolenia styliformis* Brightwell

St. **RS 17**. 3. i. 29. 74° 06′ S, 178° 55′ E. 100–0 m.

*Corethron criophilum* Castracane
*Chaetoceros criophilum* Castracane

St. **RS 19**. 6. i. 29. 73° 08′ S, 175° 50′ E. 100–0 m.
Temp. 1·50° C.

*Corethron criophilum* Castracane

St. **RS 20**. 8. i. 29. 72° 30′ S, 176° 18′ E. 100–0 m.
Temp. 0·00° C.

*Corethron criophilum* Castracane

St. **RS 23**. 17. i. 29. 74° 20′ S, 179° 50′ E. 100–0 m.
Temp. 0·85° C. Salinity 34·17 ‰.

*Corethron criophilum* Castracane

St. **RS 27**. 31. i. 29. 73° 10′ S, 179° E. 100–0 m.
Temp. – 0·60° C.

*Corethron criophilum* Castracane
*Chaetoceros criophilum* Castracane

## DIATOMS FROM MELTED ICE

Near St. **560**. 30. xii. 30. R.R.S. 'Discovery II'. Approximate position 66° 47′ S, 69° 19′ W.

*Fragilaria curta* H. van Heurck
*Fragilaria linearis* Castracane
*Nitzschia Barbieri* H. van Heurck var. *minor* M. Peragallo
*Navicula subpolaris* (M. Peragallo) Hendey
*Fragilaria antarctica* Castracane
*Charcotia bifrons* (Castracane) Peragallo
*Chaetoceros dichaeta* Ehrenberg
*Rhizosolenia polydactyla* Castracane
*Navicula corymbosa* (Agardh) Cleve
*Amphiprora Oestrupii* H. van Heurck
*Tropidoneis belgicae* (H. van Heurck) Heiden et Kolbe

## MARINE BIOLOGICAL STATION

St. **MS 86**. 25. xi. 30. 2 miles ESE of King Edward Point, East Cumberland Bay, South Georgia. 50–0 m.
Temp. 2·10° C. Salinity 33·22 $^\circ/_{\circ\circ}$. *p*H 8·07. $P_2O_5$ 88.

*Chaetoceros criophilum* Castracane
*Corethron criophilum* Castracane
*Biddulphia striata* Karsten
*Eucampia balaustium* Castracane
*Fragilariopsis sublinearis* (H. van Heurck) Heiden et Kolbe
*Thalassiosira antarctica* Comber
*Asteromphalus Hookerii* Ehrenberg
*Coscinodiscus centralis* Ehrenberg
*Rhizosolenia styliformis* Brightwell

St. **MS 88**. 10. xii. 30. Position as St. **MS 86**. 50–0 m.
Temp. 2·75° C. Salinity 32·63 $^\circ/_{\circ\circ}$. *p*H 8·07. $P_2O_5$ 72.

*Fragilariopsis sublinearis* (H. van Heurck) Heiden et Kolbe
*Coscinodiscus centralis* Ehrenberg
*Chaetoceros criophilum* Castracane

Sts. **MS 89, 90, 92**. 18. xii. 30–8. i. 31. Position as St. **MS 86**. 50–0 m.

*Fragilariopsis sublinearis* (H. van Heurck) Heiden et Kolbe
*Coscinodiscus centralis* Ehrenberg
*Licmophora Lyngbyei* (Kützing) Grunow

St. **MS 94**. 8. i. 31. Moranen Fjord, South Georgia. 36–0 m.
Temp. 1·70° C. Salinity 30·88 $^\circ/_{\circ\circ}$. *p*H 8·22. $P_2O_5$ 54.

*Coscinodiscus centralis* Ehrenberg
*Chaetoceros criophilum* Castracane
*Corethron criophilum* Castracane
*Coscinodiscus oculus-Iridis* Ehrenberg

St. **MS 95**. 15. i. 31. 2 miles ESE of King Edward Point, East Cumberland Bay, South Georgia. 50–0 m.
Temp. 1·50° C. Salinity 33·58 $^\circ/_{\circ\circ}$. *p*H 8·12. $P_2O_5$ 83.

*Coscinodiscus centralis* Ehrenberg
*Fragilariopsis sublinearis* (H. van Heurck) Heiden et Kolbe
*Coscinodiscus oculus-Iridis* Ehrenberg
*Licmophora Lyngbyei* (Kützing) Grunow

St. **MS 97**. 22. i. 31. Position as St. **MS 95**. 50–0 m.
Temp. 2·90° C. Salinity 32·56 ‰. *p*H 8·07. $P_2O_5$ 51.

*Coscinodiscus centralis* Ehrenberg
*Coscinodiscus oculus-Iridis* Ehrenberg
*Fragilariopsis sublinearis* (H. van Heurck) Heiden et Kolbe
*Licmophora Lyngbyei* (Kützing) Grunow
*Corethron criophilum* Castracane
*Entopyla kerguelensis* Karsten
*Cocconeis pinnata* Gregory ex Greville
*Cocconeis imperatrix* Schmidt

St. **MS 98**. 29. i. 31. Position as St. **MS 95**. 50–0 m.
Temp. 2·50° C. Salinity 32·25 ‰. *p*H 8·07. $P_2O_5$ 83.

*Fragilariopsis sublinearis* (H. van Heurck) Heiden et Kolbe
*Coscinodiscus centralis* Ehrenberg
*Licmophora Lyngbyei* (Kützing) Grunow
*Coscinodiscus oculus-Iridis* Ehrenberg

St **MS 99**. 5. ii. 31. Position as St. **MS 95**. 50–0 m.
Temp. 2·85° C. Salinity 32·66 ‰. *p*H 8·12. $P_2O_5$ 84.

*Fragilariopsis sublinearis* (H. van Heurck) Heiden et Kolbe
*Coscinodiscus centralis* Ehrenberg
*Licmophora Lyngbyei* (Kützing) Grunow
*Biddulphia striata* Karsten
*Corethron criophilum* Castracane

St. **MS 100, 101, 102, 103**. 12. ii. 31–5. iii. 31. Positions as St. **MS 95**. 50–0 m.

*Fragilariopsis sublinearis* (H. van Heurck) Heiden et Kolbe
*Coscinodiscus centralis* Ehrenberg
*Licmophora Lyngbyei* (Kützing) Grunow
*Corethron criophilum* Castracane
*Cocconeis antiqua* Tempere et Brun
*Coscinodiscus oculus-Iridis* Ehrenberg

## CLASSIFICATION

The classification of diatoms has undergone considerable change from time to time, and the earlier schemes such as those proposed by Wm Smith (1853) and others, based upon the modes of living adopted by the various species, have been entirely abandoned; during recent years the classification proposed by Schütt in 1896 has completely dominated the literature.

The fundamental principle of Schütt's scheme is the division of the entire group into two suborders, namely Centricae and Pennatae.

In the Centricae the main structure of the valve was said to be arranged with reference to a central point, either radiating from it or concentric about it. In the Pennatae the structure was said to be arranged with reference to a median line; this line frequently corresponded to the raphe which connects the polar nodules of the valve, and was at right angles to the principal axis of the frustule.

This method has been adopted in the main by Karsten (1905, 1928). Heiden and Kolbe (1928) changed the names of the two suborders to Radiales and Bilaterales and Hustedt (1930) changed them to Centrales and Pennales; in fact all authors of the last forty years have been influenced by Schütt.

Owing to the difficulty of tracing the phylogeny of the diatoms or their affinities with other groups, Karsten (1928) suggested that their status should be raised to that of a division of the vegetable kingdom under the name of Bacillariophyta; but the fundamental idea of Schütt's two suborders was allowed to remain unchanged.

For some considerable time I have felt dissatisfied with Schütt's method of classification and with every modification of it that insists upon the two suborders based upon either radial and concentric structure on the principal axis or isobilateral structure upon the polar axis of the valve, for a large number of genera that have been included in Centricae possess neither radial nor concentric structure, and their construction can in no way be referred to a central point. Mention has only to be made of *Biddulphia*, *Chaetoceros*, *Anaulus* and *Rhizosolenia* to bring to mind a large group of forms which strictly speaking cannot be brought into line with the general idea of radial symmetry so clearly portrayed in such genera as *Coscinodiscus*, *Actinoptychus*, etc.

The shortcomings of the scheme are not apparent so long as one's attention is confined to the study of fossil or freshwater material, which is usually strongly siliceous and in the main composed of forms which lend themselves readily to such a classification. But when the weakly siliceous plankton diatoms are studied, one is immediately struck with the inadequacies of Schütt's scheme, which does not pay sufficient attention to the structure of several groups of marine diatoms that constitute a considerable proportion of the phytoplankton. With the increasing importance of the study of marine diatoms, and the advance in our knowledge of their structure, it is necessary to revise the classification and the following scheme is therefore proposed.

Diatoms are considered as a class of Algae, Bacillariophyceae, comprising one order, Bacillariales, which is divided into the following ten suborders.

DISCINEAE. Valves disciform, usually flat or convex, but occasionally concave. Frustules usually much greater in diameter than in thickness. Valves sometimes hemidisciform, frustules cuneate. Valves usually covered with puncta or areolations which radiate from the centre. Connecting zone usually simple, spinulae present or absent. Structure equal on all radii.

AULACODISCINEAE. Valves disciform, flat or convex, punctate or areolate, markings usually radial. Valve furnished with a number of pediform processes. Connecting zone simple.

AULISCINEAE. Valves circular, oval or triangular, usually flat, furnished with large ocelli. Valve covered with punctation or sculptured lines, usually arranged with reference to the ocelli.

BIDDULPHIINEAE. Valves angular, seldom round, angles furnished with strong processes; spines present or absent; markings granular or hexagonally areolate, sometimes radial, usually arranged with reference to the angles of the valve. Valve usually compound, laminate. Thickness of frustule usually more than the diameter of the valve. Connecting zone usually simple.

SOLENIINEAE. Valves circular or subcircular, domed or conical, seldom flat, frequently apiculate; apicule eccentric or marginal; markings fine, granular, often absent. Valves frequently armed with a circlet of spines. Connecting zone usually complex, composed of numerous scale-like intercalary bands, annular, imbricate or squamose, usually considerably longer than the diameter of the valve. Frustule weakly siliceous, extreme development of the connecting zone.

ARAPHIDINEAE. Valves linear to linear-lanceolate, straight or arcuate, sometimes spathulate, nodules absent. Pseudoraphe present or absent. Mainly colonial forms.

RAPHIDIOIDINEAE. Valves arcuate, sublunate to hemispherical, or club-shaped. Rudimentary raphe on one or both valves, developed in the polar areas; no central nodule.

MONORAPHIDINEAE. Valves oval, oval-lanceolate. Valves dissimilar, one bearing a true raphe, the other a pseudoraphe.

BIRAPHIDINEAE. Valves lanceolate to oval, sometimes sigmoid, arcuate or sublunate, showing isobilateral, zygomorphic or dorsiventral symmetry. Flat or twisted. Polar and central nodules usually well developed. A true raphe upon each valve.

SURIRELLINEAE. Valves oval-lanceolate, obovate or subrectangular, flat, twisted or genuflexed, nodules absent. Each valve furnished with a pseudoraphe in the polar axis and peripheral alate canal-raphe. Frustules solitary.

The first five suborders correspond to Schütt's Centricae, but I find great difficulty in referring the structure of many of the Auliscineae and Soleniineae to a radial or concentric framework, and find it quite impossible in the Biddulphiineae and Anaulineae.

The Biddulphiineae are easily understood if the structure of *Triceratium favus* is considered. In this biddulphioid diatom there exists a peculiar form of polymorphism (the word is used in its widest sense) which provides a series of forms possessing from two to thirteen angles. The structure of the valve may be likened to the effect produced when a sheet is flung upon a number of short stakes erected at equal distances from each other and in some definite geometrical pattern. The sheet may be said to be slung "hammock fashion" upon the stakes. In the same way the valve substance of the biddulphioid diatoms must be considered as being stretched upon a number of circumferential foci. The cornutate processes of the valve are the main features of the valve view, and the structure of the valve is usually arranged with reference to the adjacent process, each angle with its reinforced horn providing an independent growing point. Young or immature valves formed within the parent frustule during multiplication by fission are frequently found to produce the processes first.

This method of growth, which involves the establishment of peripheral "growing points" parallel to the principal axis of the frustule, is quite different from the type of development found in the Discineae. A similar type of peripheral structure, which adopts bipolarity as an outstanding feature, is seen in *Chaetoceros*, *Hemiaulus*, *Attheya*, *Eucampia* and many other genera.

The last five suborders correspond to Schütt's Pennatae, and in the main they agree with the idea of isobilateral construction. Difficulties in this respect are, however, encountered in the genus *Campylodiscus*.

*Campylodiscus* and *Surirella* have been separated from the Biraphidineae on account of the complex raphe system of the former. The Surirellaceae have a different valve structure from any of the families of the Biraphidineae. On both sides of each valve of a *Surirella* there is a true canal-raphe, supported above the surface of the valve by a wing-like projection; a series of capillary tubes through the supporting columns of the wing are filled with protoplasm and so maintain contact between the inner cell contents and the medium in which the diatom lives. In addition there is a pseudoraphe upon each valve in the polar axis.

This classification differs in no material respect from that of Schütt's with the exception that it does not recognize the initial division into two groups according to the so-called centric and pennate construction.

The following list shows the systematic position assigned to the genera examined in the preparation of this paper.

# ALGAE

## Class BACILLARIOPHYCEAE

## Order *BACILLARIALES*

### Suborder DISCINEAE

### Family COSCINODISCACEAE

### Subfamily *MELOSIROIDEAE*

*Melosira* Agardh
*Hyalodiscus* Ehrenberg

### Subfamily *SKELETONEMOIDEAE*

*Skeletonema* Greville
*Stephanopyxis* Ehrenberg
*Detonula* Schütt

### Subfamily *THALASSIOSIROIDEAE*

*Thalassiosira* Cleve
*Coscinoscira* Gran
*Lauderia* Cleve
*Schroderella* Pavillard
*Bacteriosira* Gran

### Subfamily *COSCINODISCOIDEAE*

*Coscinodiscus* Ehrenberg
*Charcotia* M. Peragallo
*Planktoniella* Schütt
*Gossleriella* Schütt
*Schimperiella* Karsten
*Actinocyclus* Ehrenberg

### Family HEMIDISCACEAE

### Subfamily *HEMIDISCOIDEAE*

*Hemidiscus* Wallich

### Family ACTINODISCACEAE

### Subfamily *STICTODISCOIDEAE*

*Stictodiscus* Greville
*Arachnoidiscus* Ehrenberg

### Subfamily *ACTINOPTYCHOIDEAE*

*Actinoptychus* Ehrenberg

### Subfamily *ASTEROLAMPROIDEAE*

*Asterolampra* Ehrenberg
*Asteromphalus* Ehrenberg

## Suborder AULACODISCINEAE

### Family EUPODISCACEAE

### Subfamily *PYRGODISCOIDEAE*

*Pyrgodiscus* Kitton

### Subfamily *AULACODISCOIDEAE*

*Aulacodiscus* Ehrenberg

### Subfamily *EUPODISCOIDEAE*

*Eupodiscus* Ehrenberg

## Suborder AULISCINEAE

### Family AULISCACEAE

### Subfamily *AULISCOIDEAE*

*Auliscus* Ehrenberg

## Suborder BIDDULPHINEAE

### Family BIDDULPHIACEAE

### Subfamily *BIDDULPHIOIDEAE*

*Biddulphia* Gray
*Cerataulus* Ehrenberg
*Cerataulina* H. Peragallo ex Schütt
*Bellerochea* Van Heurck

### Subfamily *TRICERATIOIDEAE*

*Triceratium* Ehrenberg
*Trigonium* Cleve
*Ditylum* Bailey
*Pseudo-triceratium* Grunow
*Lithodesmium* Ehrenberg

### Subfamily *HEMIAULOIDEAE*

*Hemiaulus* Ehrenberg

### Subfamily *EUCAMPIOIDEAE*

*Eucampia* Ehrenberg
*Climacodium* Grunow
*Streptotheca* Shrubsole

### Family ANAULACEAE

### Subfamily *ANAULOIDEAE*

*Anaulus* Ehrenberg

### Family CHAETOCERACEAE

#### Subfamily *CHAETOCEROIDEAE*

*Chaetoceros* Ehrenberg

## Suborder SOLENIINEAE

### Family BACTERIASTRACEAE

#### Subfamily *BACTERIASTROIDEAE*

*Bacteriastrum* Shadbolt

### Family RHIZOSOLENIACEAE

#### Subfamily *RHIZOSOLENIOIDEAE*

*Rhizosolenia* (Ehrenb.) ex Brightwell
*Guinardia* H. Peragallo

### Family LEPTOCYLINDRACEAE

#### Subfamily *LEPTOCYLINDROIDEAE*

*Leptocylindrus* Cleve
*Dactyliosolen* Castracane

### Family CORETHRONACEAE

#### Subfamily *CORETHRONOIDEAE*

*Corethron* Castracane

## Suborder ARAPHIDINEAE

### Family FRAGILARIACEAE

#### Subfamily *FRAGILARIOIDEAE*

*Fragilaria* Lyngbye
*Fragilariopsis* Hustedt
*Asterionella* Hassall ex Wm Smith
*Synedra* Ehrenberg
*Thalassiothrix* Cleve et Grunow
*Thalassionema* Grunow ex Hustedt

#### Subfamily *MERIDIONOIDEAE*

*Meridion* Agardh

#### Subfamily *TABELLARIOIDEAE*

*Tabellaria* Ehrenberg
*Grammatophora* Ehrenberg
*Rhabdonema* Kützing
*Licmophora* Agardh
*Entopyla* Ehrenberg

## Suborder RAPHIDIOIDINEAE

### Family EUNOTIACEAE

*Eunotia* Ehrenberg

## Suborder MONORAPHIDINEAE

### Family ACHNANTHACEAE

#### Subfamily *ACHNANTHOIDEAE*

*Achnanthes* Bory

#### Subfamily *COCCONEIOIDEAE*

*Cocconeis* Ehrenberg

## Suborder BIRAPHIDINEAE

### Family NAVICULACEAE

#### Subfamily *NAVICULOIDEAE*

*Navicula* Bory
*Trachyneis* Cleve
*Pleurosigma* Wm Smith
*Scoresbya* Hendey

#### Subfamily *AMPHIPROROIDEAE*

*Tropidoneis* Cleve
*Amphiprora* Ehrenberg

### Family GOMPHONEMACEAE

#### Subfamily *GOMPHONEMOIDEAE*

*Gomphonema* Agardh

### Family CYMBELLACEAE

#### Subfamily *CYMBELLOIDEAE*

*Cymbella* Agardh
*Amphora* Ehrenberg

### Family EPITHEMIACEAE

#### Subfamily *EPITHEMIOIDEAE*

*Epithemia* Brébisson

### Family BACILLARIACEAE

#### Subfamily *NITZSCHIOIDEAE*

*Nitzschia* Hassall
*Chuniella* Karsten

#### Subfamily *BACILLARIOIDEAE*

*Bacillaria* Gmelin

## Suborder SURIRELLINEAE

### Family SURIRELLACEAE

#### Subfamily *SURIRELLOIDEAE*

*Surirella* Turpin

#### Subfamily *CAMPYLODISCOIDEAE*

*Campylodiscus* Ehrenberg

# GENERAL NOTES

## THE SPECIES AS A POLYPHASIC SYSTEM

When attempting systematic work of any kind, sooner or later, the "species problem" has to be faced. The problem in its widest aspect presents a twofold difficulty. In the first place one has to frame a species concept, and, secondly, give it adequate terminological expression.

I conceive the species as an orbital system of disparate units expressing itself in time and space, somewhat analogous to a solar system. Under normal conditions the units are concentrated into genic clusters and scatter centrifugally as conditions become adverse. The whole system is analogous to a complex kinetic system, in which the units act and are acted upon at random. An association of several such discrete systems constitutes a generic cluster. A collection of individual variants under any given set of environmental factors constitutes what I call a phase. The conception of a species as a polyphasic orbital system of genic clusters of individuals of the same rank obviates the use, as subspecific entities, of such taxonomic groups as variety and form. The use of these terms has been avoided in connection with organisms which, although they have a different appearance, are linked together by series of intermediates which make the boundaries of the taxonomic groups previously used for them entirely unrecognizable, and force us to admit specific unity. Some forms exhibit a set of characters at one end of the cell, and an entirely different set at the other, so that if the ends were considered separately, authors in the past have regarded them as different species. Such variations have been interpreted as phases of the one species, and as a result the number of specific names used has been reduced. The phases are described by the epithets they replace. For example, *Rhizosolenia hebetata* Bailey, a large and variable species, is found possessing either plain deeply conical valves, or deeply conical valves terminated by a long slender spine. The former is what might be called the type phase, that is, it corresponds with the original description, and the latter is described as the "*semispina*" phase, as it corresponds with *R. semispina* Hensen, which has been described as a form of *R. hebetata* by Gran. Often specimens are found possessing the characters of one species at one end of the cell and characters of the other species at the opposite end. Gran (1904) described such combinations under the name *R. hebetata* (Bail.) Gran emend. Two forms were described, forma *hiemalis* Gran, and forma *semispina* (Hensen) Gran. Under the former Gran placed as a synonym, *R. hebetata* Bailey, and under the latter *R. semispina* Hensen. Gran was followed by Hustedt and Lebour. For my own part I do not favour this treatment of the subject, because if the type of *R. hebetata* Bailey is placed in the synonymy of *R. hebetata* forma *hiemalis* Gran, and *R. semispina* Hensen is placed in the synonymy of *R. hebetata* forma *semispina* (Hensen) Gran, we might well ask what is *R. hebetata* (Bail.) Gran emend. Apparently it has no standing in itself but only in the two forms that compose it.

Another outstanding example of the application of what might be called the phase concept of the species is seen in the *Corethron* population. The genus *Corethron* is considered here as a monotypic genus, the type species being *C. criophilum* Castracane. Apart from the type phase, four other phases of the one species are recognized, which correspond to *C. hystrix*, *C. hispidum*, *C. inerme* and *C. pelagicum*. All of these names I place in the synonymy of the type, and the phases are designated, for convenience, by the specific epithets they replace. In this manner the unity of all these diverse forms is recognized under one specific name, and the phase variation expressed in terms which are well known to workers in the group. The advantages of such a method are obvious; while the recognition of specific unity amongst the various forms allows the whole population to be expressed by one specific name, simplification in nomenclature is obtained, and—of greater importance—the variations, which in *Corethron* are correlated with geographical areas, may be specified without having to resort to the use of the subspecific ranks, variety and form. In diatoms no one is yet in a position to say what these subspecific ranks mean, how or in what respects a variety differs from a form or what relation either has to the species. Where I have been able to find a series of intermediate forms connecting a species with a so-called variety in such a way that it would be impossible to tell where the variety began and where the species ended, I have refrained from using the varietal rank. My method of expressing the relationship of these forms is more direct: to take my first example, we are dealing with one species, namely, *Rhizosolenia hebetata* Bailey; as far as present-day research carries us, we recognize two phases of the one species, and I find it undesirable to adopt any legal subspecific ranks to designate them. Occasionally I have retained the varietal names used by authors, but only because I have not had at my disposal a sufficient number of specimens that would indicate unity with the respective types. That such a unity exists is to my mind beyond question.

It appears to me to be a matter of the utmost importance that every name should be referred to a published description and illustration by which the organism named can be identified. Whether the citation given be the original, or whether the name used be technically correct is a matter of secondary importance. In dealing with the specific names used in the following systematic account, care has been taken to use the specific name under which the organism was first described, providing that name does not violate the fundamental principle as set out above. Original references and synonyms are quoted, and where illustrations and descriptions are alleged to be the originals of some well-known species, but by reason of ambiguity offer reasonable grounds for doubt, later combinations have been adopted. An example of this is seen in *Licmophora Lyngbyei*. *Licmophora abbreviata* (Hustedt, 1931), based on *Echinella cuneata* Lyngbye, has been used for this organism. Personally, I think the description and illustrations provided by Lyngbye are very vague, and I am very doubtful whether Lyngbye's species is identical with what we call *Licmophora Lyngbyei* Grunow to-day. Consequently I have adopted Grunow's combination, for there is no question whatever that the organism so named is identical with that in the material examined, and the use of Grunow's name for this organism fixes its identity.

With generic names there is some difference. It will always be a matter of opinion how many genera are necessary to interpret adequately any given population, but providing such names are legal and valid the number is of little consequence. It is surprising, however, that a large number of generic names now in use are illegitimate, and have no legal standing, or are used in an entirely different sense from that in which they were created. *Pleurosigma*, *Rhabdonema*, *Nitzschia*, *Rhizosolenia*, and in a different way *Melosira*, are a few examples included in this work. In view of the fact that the International Botanical Congress has taken steps to enquire into the position of the generic names of diatoms, with a view to recommending for conservation illegitimate names in current use, these names have been provisionally accepted in the sense in which they are used to-day.

## TAXONOMIC NOTES

The following notes seek to explain the more difficult problems that have arisen in the preparation of this systematic account, and to give a general outline of the methods of dealing with the more complicated groups. The treatment of some of the larger genera is quite orthodox despite the fact that revision in some cases is urgently needed. When dealing with such groups it has been considered advisable to recognize as many divisions as are deemed necessary for the interpretation of the diatom population under consideration.

Throughout this work every effort has been made to regard all of the problems from a biological point of view and to seek a connection between the terms, species, structure, function and environment.

For convenience of reference the notes are arranged under subordinal headings in systematic sequence.

### DISCINEAE.

The family Coscinodiscaceae claims by far the greatest variety of genera found in the plankton, representing about 30 per cent of the total number of species.

In the genus *Melosira* four species only were observed, *Melosira sol* being fairly abundant at St. WS 481. The peculiar form *Melosira sphaerica* Karsten was encountered occasionally but never in great numbers. This species I regard as a truly planktonic, cold-water form which prefers a low salinity; I doubt very much whether it is a true *Melosira*, but could not obtain it in sufficient quantities to make as detailed an examination as I would have wished. The plasticity of its cells and its irregular chain formation indicate special modifications to meet oceanic requirements.

*Hyalodiscus* was poorly represented; three species were recorded when the net touched bottom off South Georgia. *Skeletonema* was represented by one species only, namely *S. costatum* (Greville) Cleve, which occurred frequently in the plankton of the Peru current, taken on a line of inshore stations between 20 and 40° S.

Two species of *Stephanopyxis* were recorded, namely, *S. Palmeriana* and *S. turris*, the former being abundant off the east coast of Africa and around the Cape of Good Hope. Great difficulty was experienced at times in separating these two species, for many intermediate forms exist. *S. Palmeriana* appears to favour tropical and subtropical waters and a fairly high salinity. *Stephanopyxis turris*, on the other hand, frequents temperate waters, is much smaller in diameter, stouter in structure and usually constricted in the valve mantle.

Under the subfamily Thalassiosiroideae are grouped together two truly planktonic sections of diatoms, one mainly inhabiting temperate and cold waters, the other preferring subtropical waters of fairly high salinity and a high hydrogen-ion concentration. In the first section, *Thalassiosira* of Cleve is the most important, six species being recorded; *T. antarctica* Comber and *T. subtilis* (Ostenfeld) Gran frequently occurred in enormous colonies. The former exhibited much variation in size and coarseness of marking and enjoyed a very wide distribution. Auxospores and resting spores were observed in some of the species.

The genus *Schroderella* of Pavillard is the most important of the second section; two species were recognized, namely, *S. delicatula* and *S. Schroderi*. These have been combined by some authors, but from the material under consideration no facts emerged that would warrant such a course being taken. *S. delicatula* was abundant at some stations off the Cape, while *S. Schroderi* was frequently observed in the Peru current.

In the subfamily Coscinodiscoideae two main groups are again recognized; first, the complex genus *Coscinodiscus* and *Charcotia* and *Actinocyclus*, which are in the main heavy forms (some are truly planktonic, but many are bottom forms); and secondly, what might be described as the "levigated discoids", including *Planktoniella*, *Valdiviella*, *Gossleriella*, etc.

In the genus *Coscinodiscus* the analysis adopted by Rattray (1890) has been used. This is based on the disposition of the markings upon the valve surface and is as follows:

*Inordinatae:* forms with markings usually granular, and arranged irregularly.

*Excentricae:* forms with areolate markings which do not radiate from the centre of the valve; areoles in slightly curved and nearly parallel rows.

*Lineatae:* forms with markings usually areolate, which run across the valve in straight lines.

*Fasciculatae:* forms with areoles forming sectors; areoles in parallel lines.

*Radiatae:* forms with areoles in more or less straight lines radiating from the centre of the valve.

*Stellatae:* forms with a central stellate group of nodules or thickenings; markings very fine, usually radiate.

Nearly forty species have been recorded, the majority being found in temperate or cold water. The heavy forms were found at no time in great quantities, but occurred chiefly in samples where the net had touched bottom.

Those species which are to be considered true members of the plankton occurred occasionally as almost pure gatherings. The chief among these being *Coscinodiscus centralis*, *C. sub-bulliens*, and *C. bouvet*. The first two are closely allied species and are frequent members of northern plankton, though *C. bouvet* has not yet been recorded from northern waters. *C. kerguelensis* might also be mentioned as a truly planktonic form which occurred in fair quantities. All of these are subpolar forms. The genus was represented in the plankton of warmer waters mainly by *C. gigas* and *C. concinnus*; both favour a high salinity and are weakly siliceous.

The genus *Charcotia* of Peragallo has been adopted on account of the dissimilarity of the valvar markings and the localization of its distribution. These organisms are very characteristic, and although they should be regarded as bottom forms are to be found occasionally in the plankton.

The levigated discoids are a peculiarly interesting group and might be regarded as being derived from bottom forms. They may have adapted themselves to a planktonic existence by the development of certain structures that increase buoyancy and so enable heavy frustules to overcome the decrease in density of the surface layers of the ocean. This is accomplished by the production either of coronas of spines or circumferential loculi which may be filled with gases or liquids of low density. In *Gossleriella* the former method is used. Considerable variation in the degree of spininess was observed. The valve may develop one, two or even three rows of spines around its circumference, and in some specimens a group of spines was observed springing from the centre of the valve face. This suggests that valve-to-valve linking might take place in an attempt to adopt colonial habits. In *Planktoniella* the second method is adopted. The valve proper is stout, and as a rule strongly siliceous, and is furnished with a peripheral wing-like expansion, divided by radial rays, producing a number of chambers. These chambers may have the property of becoming turgid or flaccid according to the requirements of the organism. By the regulation of the turgidity of the peripheral chambers it is likely that the organism can change its habit from a bottom form to that of a true plankton form as occasion demands.

The family Actinodiscaceae might be conveniently divided into oceanic forms and neritic forms. In the first class are *Asterolampra* and *Asteromphalus*.

*Asterolampra* is a temperate to tropical genus favouring a rather high salinity. A small form of *A. marylandica* was frequently observed in the Atlantic between the Equator and the latitude of 40° S. This form possessed seven rays and was remarkably constant in diameter. A specimen possessing eight rays was also observed near the Equator. The variation in the number of rays is of no specific importance, as this is controlled by the internal pressure of the frustule. In the genus *Asteromphalus* the habit is truly oceanic, and the species are widespread in the sub-Antarctic Zone, although they never appear in great numbers. *A. parvulus*, a small form, was found very far south in the Weddell Sea.

The genera *Stictodiscus* and *Arachnoidiscus* are littoral, although the former is sometimes observed in deep-sea plankton. The occurrence of *A. Ehrenbergii* in the cold waters of the Bransfield Strait was rather surprising, as this species is usually confined to subequatorial regions. The frustules were large and vigorously developed and appeared to differ in no way from the specimens obtained from warm water. It is a complete mystery how this species became established in so cold a habitat. A careful examination of all the plankton from a long line of inshore stations along the Chili-Peru coast did not reveal any trace of it. The species is frequently found off the coasts of Japan and California, but it is almost inconceivable that the Bransfield colony originated from California, as there is no surface current which would account for this extension of its range. Information received from Mr John A. Long of Leeds, indicates that *A. Ehrenbergii* has established itself at other points within the Antarctic Circle; Mr Long has observed this species in material collected by Sir Douglas Mawson's expedition to Adelie Land.

### AULACOIDISCINAE and AULISCINAE

Although no representatives of these suborders were found in the material examined, they have been set down in the systematic arrangement in order to show the gradual development of the frustule from the discoid to the biddulphioid form. The term biddulphioid is used to designate forms which possess a structure similar to that of species of the genus *Biddulphia* Gray. The term is rather ambiguous and is often used in a wrong sense. Its use implies angularity of valve outline, production of processes, and considerable development of the frustule along the principal or pervalvar axis.

### BIDDULPHINEAE.

This is a very large suborder which is almost exclusively marine and, with few exceptions, entirely neritic. The genera are arranged in order of decreasing silicification of the frustules, and as this advances there is a marked loss of the true biddulphioid characters and a tendency towards oceanic habits.

Our knowledge of the biddulphioid diatoms has always been in a state of confusion; attempts have been made from time to time to establish some sort of order amongst the species, but with little success.

The difficulty lies chiefly in the position of the genus *Triceratium* Ehrenberg. This genus was established in 1840; two species were described, *T. favus* and *T. striolatum*, the former being considered the type. Since that time, however, many additions have been made to the genus, in fact over 800 specimens have received specific or subspecific names. The genus was originally framed to accommodate triangular organisms, but gradually it came to include many polygonal forms which appeared to differ from one another in no other respect than in the increased number of sides. For instance, *T. favus* has been found with the number of angles varying from two to thirteen, and many of these forms have been given specific or varietal names. It must be admitted that the original generic description was rather ambiguous and led to the inclusion of almost any angular diatom, forms which in fact differed so markedly from the type species as to render the definition of the genus almost impossible. It would serve no useful purpose to recite the history of the genus, or to debate the many unsuccessful attempts that have been made towards simplification; all of them are well known to workers in the subject.

Prior to the commencement of my work upon the Discovery material I was engaged upon a monograph of the genus *Triceratium*, the completion of which was delayed by the present undertaking. Although the number of species of this genus observed in the 'Discovery' material does not allow all my recommendations to be exemplified, the main ideas and changes in nomenclature that have been found necessary are given here in so far as they apply to the species observed.

The classification, as I see it, cannot be based upon such variable features as the number of sides possessed by the frustules, the outline, form of process, arrangement of markings, or *modus vivendi*, but rather upon some feature or features which show constancy from group to group, making due allowance for variation of degree but not of kind. The only feature that satisfies these demands is the structure of the valve.

If we examine the type species, *T. favus*, we find that the valves are of a very characteristic structure, one which allows the species to be recognized instantly. This structure, which has been so ably elucidated by the work of Müller (1871) and Flögel (1884), is constant in the *favus* group, which contains about thirty species. The valve is strongly siliceous and covered entirely with a rigid hexagonal loculation, in transverse lines, open on the upper surface, but closed on the lower surface. The lower surface or floor may or may not bear markings which have been variously interpreted, the walls of the loculi may or may not be furnished with secondary markings or small spines, particularly at the points of confluence. The processes of the valve are cornutate or subcornutate.

The loculation of the entire surface of the valve is a constant character of the *favus* group, a feature which sharply defines it from the rest of the biddulphioid diatoms, and endows all the members with an appearance that is unmistakable. It is essential that the integrity of such a group should be preserved and that its absorption into another and older genus should not be permitted.

Another section of the genus which requires attention is that described as the *arcticum* group. This consists of about thirty species or varieties that are structurally allied to *T. arcticum* Brightwell. Here again, as in the *favus* group, to which the group is closely allied, the structure is found to be very characteristic. Members of the group exhibit polymorphism in the same way, and the surface structure of the valves exhibits a hexagonal aerolation. One or two important differences, however, occur. The hexagonal loculation is not always entire over the whole surface of the valve. In some species the loculation breaks down in the middle of the valve to a number of coarse granules; in others it is entire over the central area of the valve face, and is reduced to granulation at the valve mantle. The cellulation is less regular than that in *T. favus*, and as a rule radially arranged instead of being in parallel lines. In the *arcticum* group the loculi in the valve are closed both upon the outer and inner surfaces, with the exception of poroids upon the lower surface. The angles of the frustules of the *arcticum* group are furnished with a pad of minute pores, which is only very slightly raised above the level of the rest of the valve surface in some species, while in others the angles are actually lower than the central area of the valve. The pads of fine pores secrete mucus by means of which the frustules attach themselves to the substratum. Members of the group are solitary, littoral, and seldom occur in great numbers.

Research into the evolution of the biddulphioid diatoms has revealed that there exists a relation between the geographical distribution of the *favus* and *arcticum* groups and climatic conditions. Presumably these two groups emerged at about the same time, for they both make their first appearance in the same geological formation, namely, the Oligocene at Oamaru, New Zealand. Members of the genus *Triceratium* Ehrenberg from earlier deposits are particularly coarse and ill-formed, and their markings and orientation might be described as primitive. The Oamaru deposit, however, contains not only the primitive forms found in the earlier deposits, but examples of great evolutionary progress, manifest in the regular orientation of the valve surface and a laminated structure of the valve itself, as found in the *arcticum* and *favus* groups. These structural innovations proved to be advantageous, for the really coarse granular forms have become entirely extinct, and the members of the *arcticum* and *favus* groups enjoy a world-wide distribution. The earliest deposit to contain diatoms is that at Kusnetzk, in South Russia, where a great number of coarse species of *Triceratium* have been found. Only 2 per cent of the total number of diatoms of that deposit are to be found living at the present day—not one of the species of *Triceratium* has survived. If the main fossil marine deposits of the world are arranged in chronological order it will be found that the proportion of the *favus* group to the *arcticum* group varies with the temperature. Deposits laid down in tropical seas have a larger proportion of *favus* forms than those laid down in polar seas. This division is well marked in the forms found living at the present day. The *favus* group has a temperate to tropical distribution, while the *arcticum* group is subpolar.

These two groups that have established themselves throughout wide yet definite areas, and exhibit such a highly evolved structural development demand due recognition. In the absence of experimental taxonomy, the important considerations enumerated above, namely, characteristic structure, progressive development and geographical distribution, warrant the two groups being given generic status. The *favus* group has already been dealt with, and the recognition of Cleve's genus *Trigonium*, which has *T. arcticum* Cleve, based on *Triceratium arcticum* Brightwell, as the type species, satisfies all the demands of the so-called *arcticum* group.

Considering the number of inshore stations that have been examined, the number of species of *Biddulphia* and *Triceratium* observed was surprisingly few.

### Eucampioideae.

Coming to the suborder Eucampioidae, the weak silicification of the valves is very pronounced and the plants have entirely changed their habits from solitary forms to colonial. Long ribbon-like filaments of all the genera contained in the suborder are very frequent in the plankton, and some of them must be considered truly oceanic. *Eucampia balaustium*, for instance, is very common in cold water, and undergoes considerable variation in size and degree of silicification. Generally speaking the oceanic forms are more weakly siliceous than the neritic ones.

In the genera *Climacodium* and *Streptotheca* silicification is reduced to the minimum, and the latter, which is represented by one species only, can in no way be regarded as a siliceous organism in the same way, for instance, that one would regard a *Triceratium*. The frustules are quite soft and pectinous and absorb dyes readily. At this, the lower end of the Biddulphiaceae, the term biddulphioid is not applicable in its true sense, as a description of the species.

The family Anaulaceae contains one genus only, namely *Anaulus* Ehrenberg. The true position of the genus is most uncertain; there is a suggestion of biddulphioid construction, but it is not carried very far; there also appear to be certain pennate influences at work. One previously undescribed species was observed.

The last family of this suborder, namely Chaetoceraceae, is very extensive, both as regards the number of species observed and the number of organisms which occurred in the hauls. Its position in the systematic arrangement is not at all clear and it probably should not be included in Biddulphiineae. The family is confined to a marine habitat, its members being both oceanic and neritic. It is probably of recent evolution as compared with the Discineae. Considerable variation in certain species was observed, owing to the habit of producing distinctly different summer and winter forms. These seasonal forms were particularly evident in the more southerly samples, and it appears to be likely that the seasonal changes are brought about to enable the organisms to maintain their position in the surface layers of the ocean so as to make the most of the available sunlight during winter months.

The genus *Chaetoceros* has attracted the attention of many plankton workers during recent years, including Cleve, Gran, Mangin, Pavillard, Ostenfeld, Meunier and Yendo. The following classification based upon Gran's work in Nordisches Plankton (1905) is taken from Lebour (1930):

Subgenus *Phaeoceros.*

Chromatophores numerous, penetrating into the bristles. Mostly oceanic.

Sections: 1, *Atlantica*; 2, *Borealia.*

Subgenus *Hyalochaetae.*

Chromatophores solitary or in pairs, but sometimes numerous, not penetrating into the bristles. Mostly neritic.

Sections: 1, *Oceanica*; 2, *Dicladia*; 3, *Cylindrica*; 4, *Compressa*; 5, *Protuberantia*; 6, *Constricta*; 7, *Stenocincta*; 8, *Laciniosa*; 9, *Diadema*; 10, *Diversa*; 11, *Brevicatenata*; 12, *Curviseta*; 13, *Anastomosantia*; 14, *Furcellata*; 15, *Socialia*; 16, *Simplicia.*

### SOLENIINEAE.

This suborder has received less attention than any other from workers in the past, and is consequently little understood. The reason is twofold, first, that to the average worker material containing the genera here represented is seldom available, and secondly, that the inclusion of this important group of organisms under the so-called Centricae of Schütt, entirely robbed it of its individuality and obscured certain features of biological significance.

The arrangement of the families given in the systematic classification indicates a gradual recession from gonioid forms to the truly solenoid.

Apart from structural likeness in the main body of the frustule the Bacteriastraceae bear certain resemblances to the Chaetoceraceae, particularly in the method of producing resting spores; but the complete circlet of bristles in *Bacteriastrum* is quite opposed to the bipolarity of *Chaetoceros*. The circular section of *Bacteriastrum* led Lebour (1930) to include it together with *Corethron* and *Leptocylindrus* in the Discoidae; this, however, I regard as an error.

The Soleniineae are sharply defined from all other groups of diatoms both as regard geological age, distribution, structure, and habit. *Bacteriastrum* must be regarded as having a tropical to temperate distribution and is but seldom found in cold waters. It occurred frequently in plankton around South Africa. Much confusion exists concerning the various species and their geographical limits. Pavillard (1924–5) did much to dispel this, but from the material I have examined I am of the opinion that much variation takes place within the several species and that the lines of demarcation between some of them at least are very vague.

These weakly siliceous forms are so readily moulded by the varying environmental conditions as to make specific identification extremely difficult. Fortunately the species recorded from the 'Discovery' material were in most cases fairly definite, although indeterminate forms appeared from time to time. *B. elongatum* and varieties of *B. hyalinum* occurred most frequently, chiefly off the coast of South Africa. *B. comosum* occurred high up off the east coast of Africa in the equatorial zone, and this species is fairly common in the Mediterranean.

The effect of environment on the organism is best seen in the next family, namely, Corethronaceae. The type genus *Corethron* provides an opportunity for such a study, and in order to avoid the creation of a host of ill-founded species, must be approached with sanity and restraint. The genus has always been a difficulty, chiefly due to the scarcity of material or rather that material is available only upon infrequent occasions. Little or no account has been taken of the fact that *Corethron* is a genus possessing a wide geographical distribution and that its members are subjected to considerable variation in all the important factors, such as temperature, salinity, hydrogen-ion concentration, available oxygen, dissolved mineral salts, and sunlight, that control a planktonic existence. These variations are not only observed in different places, but also in the same place at different seasons of the year, or during different years, and it is reasonable to suppose that such changes produce profound effects upon the organisms.

The weakly siliceous frustules of *Corethron*, which bear few or no markings such as the granules or costae that are so characteristic of diatoms, become plastic material admirably suited to abnormal development along the principal axis, which is one of the chief characters of the suborder to which the genus belongs. As a population we are dealing with weakly siliceous organisms distributed throughout the world and accommodating themselves to every possible variation of environment.

The individuals vary considerably in shape and dimensions, some being almost spherical; but the majority of them are tubular, with the length of the frustule anything from two to fourteen times the breadth. Some of the individuals are furnished with long bristles at both ends of the frustule, others have bristles at one end only; some of the bristles bear small spines, others do not; frequently the bristles at one end of the frustule bear spines, while those at the other end are plain. The frustules often bear similar markings to those on *Rhizosolenia*. Other individuals are furnished with a corona of fine bristles bearing claw-like extremities.

Generally speaking these variants inhabit fairly well-defined areas, and their characters are thus to some extent correlated with regional distribution. The spherical forms are found off the coast of South Africa, also in the Mediterranean, and are considerably greater than the tubular ones in diameter. The population of the North Atlantic comprises cells whose length is usually about twice the breadth, these forms making their appearance in the English Channel. Moving southwards, a considerable lengthening along the principal axis (girdle view) is noticed, and in latitude 44° 52′ S the population consists entirely of forms whose length is ten to fourteen times as much as the breadth. These forms are simple hyaline tubes, having thin walls and a circlet of bristles at each end; no spines appear on the bristles. Farther south a mixture of forms is encountered whose length varies from two to ten times the breadth, and minute spines are sometimes observed on the bristles.

Still farther south, in latitude 57° 36′ S, forms of varying length are encountered bearing an inner corona of shorter bristles furnished with claws, and these are intermixed with previously described forms.

The *Corethron* population presents forms varying greatly in length, which may or may not be furnished with bristles, the bristles may or may not be furnished with spines, and coronas of claws may or may not be present. *C. criophilum*, the type of the genus, which is widespread in sub-Antarctic and Antarctic waters, was described by Castracane in 1886 in the *Reports of the Voyage of the 'Challenger'*. In 1905 Karsten described two forms from Antarctic waters, *C. valdiviae* and *C. inerme*, but Mangin (1915) held that owing to the presence of so many intermediate forms, it was impossible to distinguish the one from the other. Hart (1934) supported this view. Hustedt (1930) is certain that *C. valdiviae* of Karsten is synonymous with *C. criophilum* of Castracane, but prefers Karsten's specific name upon the grounds that his description of the organism was more accurate. For my own part, I find there is no case whatever for refusing to admit Castracane's species: the description and illustrations provided are unmistakable.

From the almost unlimited supply of material at my disposal I have no hesitation in saying that the species created by Karsten are merely phases of the one species *C. criophilum* Castracane, and that the presence or absence of *rhizosolenoid* markings, circlets of bristles, spines, or spines with claws are of no specific significance.

Regarding *C. hystrix* Hensen, I find myself in complete agreement with Ostenfeld (1902) and consider this species to be synonymous with *C. criophilum* Castracane. *C. hystrix* has been held to be separate from *C. criophilum* on account of the absence of the corona of short spines bearing claws and because the length of the frustule is seldom more than three or four times the diameter of the valve. But I find that the relation between the diameter and the length of the frustule is of no specific importance, and that the intermixture of so many forms of various lengths at many stations in the more southerly waters made it impossible to make any such separation.

Hustedt (1929) states that he has observed "klammerborsten" upon the valves of specimens from the Sea of Japan, and I have observed them upon specimens from the South Atlantic. The *rhizosolenoid* markings upon the connecting zone are to be observed upon some specimens, particularly if the material is examined when mounted dry.

*C. Murrayanum* Castracane was observed at one station only, St. 461. This form is a short stout one and the bristles are somewhat flattened and bear spines. The connecting zone is composed of annular rings, similar to those of *Coscinodiscus concinnus* Wm Smith. I consider this to be either an abnormality or a winter resting stage of the *hystrix* phase and therefore synonymous with *Corethron criophilum.*

The family Rhizosoleniaceae illustrates a marked departure from the structure and habits of the two foregoing families; the claws and bristles which are so characteristic of *Bacteriastrum* and *Corethron* are almost entirely absent, and altogether new structural ideas are developed. Extreme development of the girdle or connective zone takes place, and the valve is reduced to a relatively small cap variously terminating in a spine.

By the formation of short chains, interlacing or matting takes place, which allows the organisms to adopt colonial habits, and so to maintain their position in the surface layers of the ocean. The genus *Rhizosolenia* with few exceptions is entirely oceanic, and equally represented in cold and warm waters. Considerable variation takes place within certain species, particularly in the diameter of frustule, and this was very marked in the case of *R. hebetata.*

At few stations in the South Atlantic did members of this genus occur abundantly, and with the exception of the aforementioned species and the almost ubiquitous *R. styliformis*, few specimens were encountered until 45° S was reached. Below this latitude the genus became more frequent, particularly in the Bransfield Strait and the Bellingshausen Sea, where pure gatherings sometimes occurred.

The following classification of *Rhizosolenia*, suggested by Pavillard (1925) has been adopted.

*Inermes:* valves truncated, without terminal spine.
*Affines:* valves rounded, with short spine.
*Robustae:* valves elongated, conical, with spine.
*Imbricatae:* two rows of lateral intercalary bands, spine dorsal.
*Genuinae:* two rows of dorsiventral intercalary bands, spines long or short.
*Squamosae:* intercalary bands numerous, scale-like.

In the Leptocylindraceae all attempts at producing spines, bristles or claws are relinquished, and the solenoid or tubular development reaches its highest state. The valves are very indefinite and the connective zone is composed of intercalary bands. The family is sharply circumscribed and the genera closely related. Considerably more work on the family is required before the exact relationships are fully understood.

*Leptocylindrus* was observed but rarely, and although a certain amount of variation was seen in the specimens, all have been referred to *L. danicus* Cleve.

In the genus *Dactyliosolen* two distinct groups have been recognized; the cold-water group is typified by *D. antarcticus.* Under this specific name I have placed as synonyms Karsten's species *borealis* and *laevis*, as I have found that the characters of the one species often merge into the other upon the same specimens. For the same reason, in dealing with the warm-water group, I have placed Karsten's species *D. meleagris* and Peragallo's *D. Bergonii* in the synonymy of *D. mediterraneus* Peragallo. The cold-water forms of this genus were frequently found associated with filamentous forms of *Fragilariopsis*, particularly under neritic conditions.

ARAPHIDINEAE.

The subfamily Fragilarioideae was by far the best represented in this suborder, which contains littoral and oceanic forms. The most important forms are *Fragilariopsis antarctica*, *Thalassiothrix longissima* and *Thalassionema nitzschioides*. The first two might be considered as true oceanic forms; they occur in enormous quantities, preferring cold water and low salinity. *T. nitzschioides* occurred less abundantly and is a neritic and temperate species. *Fragilaria striatula* occurred occasionally between 34 and 43° S. No difference could be observed between these specimens and corresponding specimens found in European fresh waters. *F. curta* was obtained from melted ice taken near St. 560 in the Bellingshausen Sea, together with *F. linearis*. It is of singular importance that this was the only station in which *F. curta* occurred. It is probably littoral around the Antarctic continent. *Licmophora Lyngbyei* was another littoral diatom that occurred frequently. This species is very widespread and occurs in enormous quantities in both Arctic and Antarctic waters; it is also common around the shores of Great Britain. *Asterionella*, another littoral genus, was represented by two species, both found off the coast of Natal.

MONORAPHIDINEAE.

This suborder was poorly represented. The genera contained therein are in the main littoral and belong to that group of diatoms generally referred to as the stipitate epiphytes. The cells adhere together, usually united valve to valve, to form short chains, often enveloped in a strong mucilaginous coleoderm which may attach itself directly to the substratum by a small cushion-like dilation or become attenuated to form a long mucous stipe. The formation of the stipe gives rise to a frondose formation of the colony. One outstanding exception to the general mode of living was seen in *Cocconeis ceticola*. This must be regarded as an oceanic species and was found living singly upon and within the cutaneous investment of certain species of whales. One species, *C. Wheeleri* Hart (Hart, 1935, p. 259), was found only upon the Humpback whale, *Megaptera nodosa*. Unfortunately I have not had the opportunity of examining this species, and therefore have not included it in the systematic account. Of the genus *Achnanthes* one species only was observed, namely, *A. kerguelensis*. This species was obtained at St. WS 481 in the Bransfield Strait, where the net touched bottom. Of the genus *Cocconeis*, three littoral species were observed in addition to the parasitic *C. ceticola* mentioned above. Two of these, *C. pinnata* and the beautiful *C. imperatrix*, were obtained from the Bransfield Strait and also from shallow-water hauls made in the East Cumberland Bay, South Georgia. It is probable that *C. imperatrix* is very common around the coasts of the islands of the Southern Ocean, as examinations of deep-sea oozes, taken in the neighbourhood of Tristan d'Acunha, indicated that an enormous deposit of diatomaceous material was in the process of formation, and that *C. imperatrix* was found frequently therein.

### Biraphidineae.

Generally speaking the Biraphidineae were very poorly represented. Among the six species of *Navicula* observed, two deserve especial note. *N. lyra* Ehrenberg was observed in material from St. WS 622. Only a few specimens were found, and they differed in no way from those found around the coasts of Britain. This is the first time that this diatom has been recorded from the Antarctic. *N. membranacea* Cleve was found at St. 1373, off the coast of Natal. This peculiar form is a weakly siliceous *Navicula*, possessing considerable development in the zonal aspect, and characteristic strap-like chromatophores. It is a neritic form favouring a fairly high salinity. Two species of *Amphiprora* were observed, *A. Kjellmani* at St. 440, off the coast of Natal, and *A. Oestrupii*, a cold-water form, found in water obtained from melted ice. The former is found quite frequently in northern waters. In the subfamily Nitzschioideae the genus *Nitzschia* was represented by four species. *N. seriata* was very widespread, particularly in the more southerly waters where it existed in enormous quantities. *N. closterium* also occurred but was never abundant.

## DIVISIONS OF THE FLORA

The examination of the phytoplankton from so many different and widely spread localities has made it possible to review the various diatom floras that inhabit the southern seas. For the sake of convenience they will be dealt with in the order summarized below.

Two main floras are recognized and are controlled by the climatic conditions under which they exist. These are subdivided into groups, similar to those used by Gran, based upon the habit or mode of living adopted by the species.

(1) Warm-water flora:
  A. Oceanic:
    (*a*) Holoplanktonic.
  B. Neritic:
    (*a*) Holoplanktonic.
    (*b*) Meroplanktonic.
    (*c*) Tychopelagic.

(2) Cold-water flora:
  A. Oceanic:
    (*a*) Holoplanktonic.
    (*b*) Special:
      (i) Parasitic.
      (ii) Adventitious.
  B. Neritic:
    (*a*) Holoplanktonic.
    (*b*) Meroplanktonic.
    (*c*) Tychopelagic.

Before considering the subdivisions in detail the general construction of the two floras will be examined. Naturally these floras are not exactly distinct, and the intermingling which takes place in the transition areas makes it very difficult to define their range clearly. They have not been defined by the hydrologically determined convergence lines, but in the main the boundary between them will be found to coincide with the subtropical convergence. The floras must be considered in relation to the ocean currents that support them more than in relation to the actual degrees of latitude through which they spread. It is found that the flora of any given area varies from another in the same latitude, if the two areas are separated by any appreciable number of degrees of longitude, for instance 20 or 30°. This is due to the fact that none of the more important surface currents run directly east and west, all having some meridional component. Reference to the chart in Fig. 1 will indicate clearly what is meant. Of the Atlantic currents the warm Brazil current moving southwards along the eastern seaboard of South America enables a large warm-water flora to be supported almost as far south as 50° S, while in the eastern Atlantic and Pacific are the cold upwelled waters of the Benguela and Peru currents which support a flora which has a distinctly cold-water facies. The disposition of the land-masses in the southern hemisphere and the currents that operate around them have a marked effect upon the geographical range of the various species.

Apart from the main consideration of the oceanic currents which control to a large degree the extent of the floras borne by them, the layering and zoning of the surface waters, particularly in the South Atlantic, exert considerable influence upon certain species.

The analyses of a large number of stations have shown that it might be possible to consider a third group, that is, the "Antarctic convergence flora", which is very abundant in species and genera, and of course is an association of both cold-water and warm-water floras. The consideration of the various floras must be in relation to the factors that operate upon the species contained in them, that is, the floras are associations of organisms acting and being acted upon at random by a set of chemical and physical conditions, and it is likely therefore that modifications in structure, association and habit will result from variation in the environmental factors that occur. In the main it may be said that the warm-water flora is more weakly siliceous than that sustained by colder waters, and further that the former is much richer in genera and species while the latter is the richer in individuals.

To consider the subsections a little more closely, the terms holoplanktonic, meroplanktonic, etc., have been used more or less in the sense that Haeckel introduced them, and in the sense in which they have been used subsequently by Ostenfeld and Lebour. Under holoplanktonic are included the organisms which spend the whole of their time as free-floating individuals. All truly oceanic species are holoplanktonic, and in certain conditions several species which are regarded as belonging to the neritic flora are holoplanktonic also. Tychopelagic species are those which spend most probably the greater part of their life as bottom forms lying in mud or attached to a substratum, forming ribbon-like bands and only entering the surface layers of the sea if torn forcibly from their natural habitat by rough weather. Meroplanktonic species are littoral in so far that they are associated with a coast-line. They are often chain-forming species which may attach themselves to larger algae or rocks, but are never bottom forms, in the sense that true tychopelagics are. Meroplanktonic forms are often found living under oceanic conditions, and no sharp line of definition can be drawn between the two categories. The division might be summarized by stating that all true oceanic species are holoplanktonic, whereas the neritic flora may consist of several holoplanktonic species together with meroplanktonic and tychopelagic ones.

The following notes and tables indicate the distribution of various floras referred to. It will be noticed that sometimes in the table dealing with the cold-water flora the same species is indicated as being found in the oceanic flora and the meroplanktonic group of the neritic flora. This has been done to express the cosmopolitan nature of the species and to indicate its association with the neritic flora generally, and is not meant to indicate that the species is entirely dependent upon the coast-line.

## (1) Warm-water flora

### A. *Oceanic.*

Concerning the holoplanktonic flora of tropical and subtropical waters very little can be said. The reason for this is that the stations established within the tropical and subtropical Zones at which a truly oceanic flora was obtained were very poor in diatoms. The few stations on the 30th W meridian which fell within these zones provided a fairly constant flora. It is interesting to note that the solenoid diatoms were poorly represented, while the oceanic discoid forms predominated. The genera *Chaetoceros* and *Bacteriastrum* were scarce, whereas *Hemidiscus* and *Asterolampra* were very common. Several neritic species were observed associated with this oceanic flora, for example, *Fragilaria striatula* and *Melosira sulcata*. *Planktoniella sol* also was observed in considerable numbers, but was not so numerous as around the coast of South Africa.

### B. *Neritic.*

The neritic flora of the warm waters was particularly interesting, although by no means complete. Concerning the holoplanktonic species in the neritic flora, those observed off the east coast of Africa were very characteristic, several species being found in no other place in the world. This African neritic flora was composed chiefly of (i) relatively large centric diatoms which by reason of the strong development of the connective zone approximated to a spherical form, (ii) a large proportion of the levigated discoids, that is, forms which produce peripheral wing-like expansions and so greatly increase their internal capacity, together with (iii) large but relatively weakly siliceous solenoid forms. To these must be added the ubiquitous *Chaetoceros* spp., which in this area favour the chain formation and the production of relatively large cells with short hair-like bristles. Several meroplanktonic species were observed also, occurring in small spirally arranged or frondose colonies. They were in no way characteristic, but species common to all coasts enjoying a temperate climate. These two sections of the neritic flora of the warm waters provided a greater diversity of species than any other.

The following table gives an idea of the distribution of the warm-water diatom flora observed in the phytoplankton examined.

### *Species typical of the warm-water flora examined*

| Species | Oceanic | | | Neritic | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Atlantic | Pacific | Indian | Atlantic Ocean | | | Pacific Ocean | | | Indian Ocean | |
| | Holoplanktonic | | | Holoplanktonic | Meroplanktonic | Tychopelagic | Holoplanktonic | Meroplanktonic | Tychopelagic | Holoplanktonic | Meroplanktonic |
| *Stephanopyxis Palmeriana* | — | — | × | — | — | — | — | — | — | × | — |
| *Thalassiosira condensata* | — | — | — | × | — | — | × | — | — | — | — |
| *Lauderia borealis* | — | — | × | — | — | — | — | — | — | × | — |
| *Schroderella delicatula* | — | — | — | × | — | — | — | — | — | × | — |
| *S. Schroderi* | — | — | — | × | — | — | × | — | — | — | — |
| *Coscinodiscus excentricus* | × | — | — | × | — | — | — | — | — | — | — |
| *C. gigas* | × | — | × | — | — | — | — | — | — | — | — |
| *C. Grani* | — | — | — | × | — | — | — | — | — | — | — |
| *C. lineatus* | — | — | — | × | — | — | — | — | — | — | — |
| *C. marginatus* | × | — | — | × | — | × ? | — | — | — | — | — |
| *Planktoniella sol* | — | — | — | × | — | — | × | — | — | × | — |
| *Gossleriella tropica* | — | — | × | — | — | — | — | — | — | × | — |
| *Actinocyclus rotula* | — | — | — | — | × | × | — | — | — | — | — |
| *Hemidiscus cuneiformis* | × | × | — | × | — | — | × | — | — | — | — |
| *Asterolampra marylandica* | × | — | × | — | — | — | — | — | — | — | — |
| *A. Vanheurcki* | — | — | — | — | — | — | — | — | — | × | — |
| *Asteromphalus elegans* | — | — | — | — | — | — | × | — | — | — | — |
| *Actinoptychus senarius* | — | — | — | × | — | — | × | — | — | × | — |
| *A. splendens* | × ? | — | — | × | × | — | — | — | — | — | — |
| *Biddulphia antediluviana* | — | — | — | — | — | — | — | × | × | — | — |
| *B. longicruris* | — | — | — | — | — | — | × | — | — | — | — |
| *B. regia* | — | — | — | — | — | — | — | — | — | × | — |
| *Cerataulina pelagica* | — | — | — | × | — | — | — | — | — | — | — |
| *Bellerochea indica* | — | — | — | — | — | — | — | — | — | × | — |
| *Triceratium favus* | — | — | — | — | × | — | — | — | — | — | — |
| *Ditylum Brightwellii* | — | — | — | × | — | — | × | — | — | — | — |
| *D. sol* | × ? | — | — | × | — | — | — | — | — | — | — |
| *Hemiaulus Hauckii* | × ? | — | × ? | × | — | — | — | — | — | × | — |
| *Eucampia cornuta* | × | — | × | — | — | — | — | — | — | — | — |
| *Climacodium biconcavum* | — | — | × | — | — | — | — | — | — | — | — |
| *C. Frauenfeldianum* | — | — | × | — | — | — | — | — | — | — | — |
| *Chaetoceros aequatoriale* | — | — | × | — | — | — | — | — | — | — | — |
| *C. atlanticum* | × | × | × | — | — | — | — | — | — | — | — |
| *C. buceros* | × | — | × | — | — | — | — | — | — | — | — |
| *C. coarctatum* | × | × | × | — | — | — | — | — | — | — | — |
| *C. dichaeta* | × | — | × | — | — | — | — | — | — | — | — |
| *C. didymum* | — | — | — | × | — | — | × | — | — | — | — |
| *C. Glandazi* | — | — | — | — | — | — | — | — | — | × | — |
| *C. Lorenzianum* | — | — | — | — | — | — | × | — | — | — | — |
| *C. messanense* | × | × | × | — | — | — | — | — | — | — | — |
| *C. Ralfsi* | — | — | — | — | — | — | — | — | — | × | — |
| *C. seychellarum* | — | — | × | — | — | — | — | — | — | — | — |
| *C. sumatranum* | — | — | × | — | — | — | — | — | — | × | — |
| *Bacteriastrum comosum* | — | — | — | — | — | — | — | — | — | × | — |
| *B. elongatum* | — | — | — | × | — | — | — | — | — | × | — |
| *B. varians* | × | — | × | — | — | — | — | — | — | — | — |
| *Rhizosolenia alata* | × | × | × | — | — | — | — | — | — | — | — |
| *R. annulata* | × | — | — | — | — | — | — | — | — | — | — |
| *R. Bergonii* | × | — | — | — | — | — | — | — | — | — | — |
| *R. calcar-avis* | × | × | × | — | — | — | — | — | — | — | — |
| *R. fragilissima* | — | — | — | × | — | — | — | — | — | × | — |
| *R. hebetata* | × | × | × | × | — | — | × | — | — | × | — |
| *R. robusta* | × | — | × | — | — | — | — | — | — | — | — |
| *R. styliformis* | × | × | × | — | — | — | — | — | — | — | — |
| *Guinardia flaccida* | — | — | — | × | — | — | — | — | — | × | — |
| *Dactyliosolen mediterraneus* | — | — | × | — | — | — | — | — | — | — | — |
| *Corethron criophilum* | × | × | × | — | — | — | — | — | — | — | — |
| *Fragilaria granulata* | — | — | — | — | × | — | — | × | — | — | × |
| *Asterionella japonica* | — | — | — | — | × | — | — | × | — | — | — |
| *A. notata* | — | — | — | — | × | — | — | — | — | — | — |
| *Synedra stricta* | — | — | — | × | — | — | — | — | — | — | — |
| *Navicula membranacea* | — | — | — | × | — | — | — | — | — | × | — |

## (2) COLD-WATER FLORA

### A. *Oceanic*.

The holoplanktonic flora of the cold waters from oceanic habitats forms the major part of the material examined in this work. Its composition might be said to consist of a small number of discoid forms and a larger proportion of filamentous pennate forms. In the main there is the enormous preponderance of the *Corethron-Chaetoceros* and *Fragilariopsis-Nitzschia* associations which are so characteristic of the Southern Ocean and associated seas.

Owing to the cold Antarctic Drift which sweeps right across the South Atlantic from Cape Horn past South Africa to the south of the Indian Ocean in an almost circumpolar fashion, very few of the species from the warmer waters ever reach far south and become established. Although cold-water species are found sometimes associating with a warm-water flora, very seldom if ever is it found that warm-water species have become established in a flora which is subject to polar or subpolar conditions. The normal habit of the holoplanktonic discoid diatoms in cold water is solitary, and only under certain conditions do they adopt colonial methods. These colonies are usually embedded within a mucilaginous film, and are probably the result of some special form of reproduction by microspores. The chaetocerids are relatively small celled, bearing very strongly developed appendages. The true solenoids, *Rhizosolenia* for example, are only locally abundant, but when present are usually long and thin, with a few important exceptions, e.g. *R. rhombus* and *R. curvata*.

The two special groups included in the oceanic cold-water flora require further definition, for in the strict sense of the term they are not truly holoplanktonic. Under the heading parasitic, I refer to the diatom population which inhabits the skin of whales, and although undoubtedly they could maintain their position in the surface layers of the sea for a short time at least, they are by no means free-floating plankton forms. This epizootic community Hart (1935) rightly has divided into two classes, viz. true constituents of the skin film, and fortuitous species. *Licmophora Lyngbyei* is included in the first class together with the specific forms of *Cocconeis*, and Hart pointed out that, although the body of the whale does not provide an ideal substratum for the former species, its extreme capacity for attaching itself to almost anything and establishing colonies with great rapidity must account for its presence upon the skin film. This property is of course the outstanding characteristic of the group of diatoms to which *Licmophora* belongs, and is noticed equally strongly developed in the allied genus *Climacosphenia*, which under subtropical conditions in Florida is regarded as a first colonist. Of the fortuitous species upon the skin film, Hart is of the opinion that as they include some of the dominant members of the neritic diatom flora they probably gain access to the whales while they are awaiting to be flensed. The most noticeable fact concerning the diatoms of the skin film is the entire absence of oceanic species, that is species which are truly holoplanktonic. The entire skin flora is either tychopelagic or meroplanktonic, most of them being stipitate epiphytes or bottom forms.

Under the heading "adventitious", I include those forms obtained from melted ice. Unfortunately, as insufficient material was examined, important comparisons with the ice flora of the Arctic, which has been investigated thoroughly by Gran (1900 *b*), could not be made. One outstanding fact, however, emerged, that is that the characteristic ice species of the Arctic are not present in the Antarctic ice flora. Gran recorded nearly thirty species of naviculoid diatoms and stated that they were represented abundantly in the polar ice and also that *Melosira hyperborea* (Grunow) Van Heurck was very characteristic of the ice floes in the Polar Sea, common in all samples, and predominant. An entirely different ice flora was discovered in the samples examined. *Fragilaria curta* and *F. linearis* were the predominant species, while *Navicula corymbosa* and *Amphiprora Oestrupii* were observed in small numbers only. These latter species are common in waters of the northern hemisphere, and were mentioned by Grunow as being found in the Arctic Sea. Several of the other species were characteristically holoplanktonic, and were probably of an entirely different origin from that of the species mentioned above. The predominant species were truly neritic, and no evidence was obtained that would suggest that the ice contained any freshwater species from the mainland.

B. *Neritic.*

Owing to the fact that the net touched bottom at several of the stations in the Bransfield Strait, this flora proved to be a rich one, particularly in the case of sections (*b*) and (*c*). Of the holoplanktonic section of this group it must be pointed out that although the discoid diatoms were represented by many different species they were very few in number as compared with the solenoid forms. Of the most interesting discoids, mention must be made of Karsten's *Coscinodiscus bouvet*, one of the only forms of that genus to adopt the chain-forming habit. This is a characteristic Antarctic species and found often in considerable numbers. It was found associating with several species of *Coscinodiscus* which are well known in northern waters.

Species of *Nitzschia* were very abundant, also certain species of *Chaetoceros*, but by far the most common form was *Corethron*. It is a matter of great difficulty to recognize the essential difference between oceanic and neritic *Corethron*.

Sections (*b*) and (*c*) of the neritic flora were observed chiefly in the material obtained from the Bransfield Strait. St. WS 481 yielded a particularly rich flora, which included several species characteristic of the Southern Ocean.

## EFFECT OF ENVIRONMENT ON FORM

A careful study of the forms found in each flora indicates that there exists a relation between structure, and the chemical and physical constants of the water that supports the population. The word "structure" is here used to indicate the size and form of the frustule and not specific orientation. It is found that there is a correlation between the internal cubical capacity and the external or surface area of a diatom frustule for a given set of physical conditions. Broadly speaking it may be said that a warm-water diatom flora is one whose individuals, under a given set of chemical and physical conditions, seek to obtain maximum cubical capacity with a minimum of surface area, whereas a cold-water diatom flora, existing under an entirely different set of conditions, seeks to obtain maximum surface area for a minimum cubical capacity in its individuals.

The poorness of the waters of the tropical and subtropical Zones in silica and nutrient salts, together with high hydrogen-ion concentration, gives rise to populations of thin-walled diatoms whose frustules have a relatively large internal cubical capacity and a relatively low surface area. As previously mentioned, various structural devices are exploited to increase the internal capacity in certain forms, e.g. the levigated discoids. Indeed, there is a marked tendency in most tropical genera to approximate to a spherical form, as a sphere provides the maximum internal capacity for the minimum surface area. This is accomplished in some species by the formation of complex annular girdles, and a deepening of the valve mantle. This endeavour to obtain a maximum internal capacity with a minimum surface area is to provide volume for metabolic products such as oil and possibly gases, which lighten the large frustules so characteristic of the tropical flora and allow them to maintain their position in the surface layers of the ocean.

Turning to the flora supported by the colder waters, it is found to be made up of species which produce small but rather more vigorous frustules, as nutrient salts in the higher southern latitudes never fall so low as to act as a limiting factor to growth. While the intense cold of the extreme south does not favour the formation of large and luxuriant individuals, the population existing within the Antarctic Zone indicates that definite modifications in size and structure are made to accommodate it to the change in environmental conditions. Thus the decrease in the size of the frustules of cold-water diatoms, probably brought about by decreased sunlight, together with heavier silicification, produces a population of greater density, that is, a population in which there is greater mass per unit volume of diatoms. It is this increased density of the individuals that makes it necessary for the surface area of the individuals to be increased if the plankton is to be maintained in the photic layers. This increase in the surface area is obtained by adopting the tubular formation of the frustule and the development of large appendages.

Among the smaller forms, members of the genus *Chaetoceros* occur abundantly in each of the two floras, but again the same general rule holds good. Tropical species of *Chaetoceros* are relatively large in the main body of the frustule and the bristles are short and thin, while in the Antarctic species the body of the frustule is reduced to a minimum, and the bristles are very long and pendulous and frequently bear spines. It is essential that the individuals of both floras possess the power of maintaining their position in the surface layers of the water in order to avail themselves of the sunlight. In some genera, e.g. *Planktoniella* and *Chaetoceros*, it is probable that the diatoms possess the faculty of exercising some control over their own buoyancy and so regulate their position in the photic layer.

Careful survey of the two floras indicates that this correlation of internal capacity and surface area plays an important part in the size modification of the species, particularly in those which are truly holoplanktonic.

## *Species typical of the cold-water flora examined*

| Species | Oceanic | | | | | | Neritic | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Bellingshausen Sea | | | Weddell Sea | Ross Sea | Southern Sea | South Georgia | | | Bransfield Strait | | Sandwich Group | | Cape Horn | |
| | Ice | Skin film | Holoplanktonic | | | | Holoplanktonic | Meroplanktonic | Tychopelagic | Meroplanktonic | Tychopelagic | Meroplanktonic | Tychopelagic | Holoplanktonic | Meroplanktonic |
| *Melosira polaris* | — | — | — | — | — | — | — | — | — | × | × | — | — | — | — |
| *M. sol* | — | — | — | — | — | — | — | — | — | — | × | — | — | — | × |
| *M. sphaerica* | — | — | — | — | — | — | × | — | — | — | — | — | — | — | — |
| *Hyalodiscus chromatoaster* | — | — | — | — | — | — | — | × | × | — | — | — | — | — | — |
| *H. kerguelensis* | — | — | — | — | — | — | — | × | × | — | — | — | — | — | — |
| *Thalassiosira antarctica* | — | — | × | × | — | × | — | — | — | — | — | — | — | — | — |
| *T. subtilis* | — | — | — | — | — | × | — | — | — | — | — | — | — | — | — |
| *Coscinodiscus variolatus* | — | — | × | × | — | × | — | — | — | — | — | — | — | — | — |
| *C. bouvet* | — | — | — | — | — | — | × | — | — | × | — | × | — | — | — |
| *C. centralis* | — | — | — | — | — | × | — | — | — | — | — | — | — | — | — |
| *C. Eta* | — | — | — | — | — | — | × | — | — | — | — | — | — | — | — |
| *C. gracilis* | — | — | — | — | — | — | × | — | — | — | — | — | — | — | — |
| *C. grandenucleatus* | — | — | — | — | — | — | × | — | — | — | — | — | — | — | — |
| *C. hexagonalis* | — | — | — | — | — | — | × | — | — | — | — | — | — | — | — |
| *C. incurvus* | — | — | — | — | — | — | × | — | — | — | — | — | — | — | — |
| *C. inflatus* | — | — | — | — | — | — | × | — | — | — | — | — | — | — | — |
| *C. intermittens* | — | — | — | — | — | — | × | — | — | — | — | — | — | — | — |
| *C. kerguelensis* | — | — | — | — | — | — | — | — | — | × | — | — | — | — | — |
| *C. lentigenosis* | — | — | — | — | — | × | — | — | — | — | — | — | — | — | — |
| *C. nitidus* | — | — | — | — | — | — | — | × | × | — | — | — | — | — | — |
| *C. oculoides* | — | — | — | — | — | × ? | × | — | — | — | — | × | — | — | — |
| *C. oppositus* | — | — | — | — | — | × | — | — | — | — | — | — | — | — | — |
| *C. pyrenoidophorus* | — | — | — | — | — | — | × | × | — | — | — | — | — | — | — |
| *C. stellaris* | — | — | — | — | — | × | — | — | — | — | — | — | — | — | — |
| *C. subtilis* | — | — | — | — | — | — | — | × | × ? | — | — | — | — | — | — |
| *C. trigonus* | — | — | — | — | — | — | × | × | — | — | — | — | — | — | — |
| *Ethmodiscus gazellae* | — | — | — | — | — | × | — | — | — | — | — | — | — | — | — |
| *E. subtilis* | — | — | — | — | — | — | × | — | — | — | — | — | — | — | — |
| *Schimperiella antarctica* | — | — | — | — | — | — | — | × | × | — | — | — | — | — | — |
| *S. valdiviae* | — | — | — | — | — | — | × | — | — | — | — | — | — | — | — |
| *Charcotia bifrons* | — | — | × | — | — | × | — | — | — | — | — | — | — | — | — |
| *Actinocyclus bifrons* | — | — | — | — | — | — | — | × | × | — | — | × | × | — | — |
| *A. elegans* | — | — | — | — | — | — | — | × | × | — | — | — | — | — | — |
| *A. intermittens* | — | — | — | — | — | — | — | × | × | — | — | × | × | — | — |
| *A. Janus* | — | — | — | — | — | — | — | × | × | — | — | — | — | — | — |
| *Stictodiscus affinis* | — | — | — | — | — | — | — | — | — | × | × | — | — | — | — |
| *Arachnoidiscus Ehrenbergii* | — | — | — | — | — | — | — | — | — | × | × | — | — | — | — |
| *Asteromphalus Hookerii* | — | — | × | × | — | × | — | — | — | — | — | — | — | — | — |
| *A. parvulus* | — | — | × | — | — | × | — | — | — | — | — | — | — | — | — |
| *B. anthropomorpha* | — | — | — | — | — | — | — | — | — | × | — | — | — | — | — |
| *Biddulphia astrolabensis* | — | — | — | — | — | — | — | — | — | × | — | — | — | — | — |
| *B. aurita* | — | — | — | — | — | — | — | × | — | × | — | — | — | — | — |
| *B. mobiliensis* | — | — | — | — | — | × | — | — | — | — | — | — | — | — | — |
| *B. polymorpha* | — | — | — | — | — | — | — | — | — | × | — | — | — | — | — |
| *B. striata* | — | — | — | — | — | × | × | — | — | — | — | — | — | — | — |
| *Trigonium arcticum* | — | — | — | — | — | — | — | — | — | × | — | — | — | — | — |
| *Eucampia balaustium* | — | — | — | — | — | — | × | × | — | × | — | × | — | — | — |
| *Anaulus ellipticus* | — | — | — | — | — | — | — | — | — | × | × | — | — | — | — |
| *A. scalaris* | — | — | — | — | — | — | — | — | — | × | × | — | — | — | — |

*Species typical of the cold-water flora examined* (cont.)

| Species | Oceanic | | | | | | Neritic | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Bellingshausen Sea | | | Weddell Sea | Ross Sea | Southern Ocean | South Georgia | | | Bransfield Strait | | Sandwich Group | | Cape Horn | |
| | Ice | Skin film | Holoplanktonic | | | | Holoplanktonic | Meroplanktonic | Tychopelagic | Meroplanktonic | Tychopelagic | Meroplanktonic | Tychopelagic | Holoplanktonic | Meroplanktonic |
| *Chaetoceros boreale* | — | — | — | — | — | × | — | — | — | — | — | — | — | — | — |
| *C. Castracanei* | — | — | — | — | — | — | — | — | — | — | — | — | — | × | — |
| *C. Chunii* | — | — | — | — | — | — | × | — | — | — | — | — | — | × | — |
| *C. criophilum* | — | — | × | × | × | × | — | — | — | — | — | — | — | — | — |
| *C. cruciatum* | — | — | — | — | — | — | × | — | — | — | — | — | — | × | — |
| *C. debile* | — | — | — | — | — | — | — | — | — | — | — | — | — | × | — |
| *C. dichaeta* | — | — | — | — | — | × | — | — | — | — | — | — | — | — | — |
| *C. neglectum* | — | — | — | — | — | × | × | — | — | — | — | — | — | × | — |
| *C. radiculum* | — | — | — | — | — | × | — | — | — | — | — | — | — | — | — |
| *C. Schimperianum* | — | — | — | — | — | — | × | — | — | — | — | — | — | — | — |
| *C. sociale* | — | — | — | — | — | — | × | — | — | — | — | — | — | × | — |
| *Rhizosolenia bidens* | — | — | — | — | — | × | — | — | — | — | — | — | — | — | — |
| *R. Chunii* | — | — | × | — | — | × | — | — | — | — | — | — | — | — | — |
| *R. crassa* | — | — | — | — | — | — | × | — | — | — | — | — | — | — | — |
| *R. curva* | — | — | — | — | — | × | — | — | — | — | — | — | — | — | — |
| *R. rhombus* | — | — | — | — | — | — | × | — | — | — | — | — | — | — | — |
| *R. styliformis* | — | — | — | — | — | × | — | — | — | — | — | — | — | — | — |
| *R. truncata* | — | — | × | — | — | — | — | — | — | — | — | — | — | — | — |
| *Leptocylindrus danicus* | — | — | — | — | — | — | — | — | — | — | — | — | — | × | — |
| *Dactyliosolen antarcticus* | — | — | — | — | — | × | — | — | — | — | — | — | — | — | — |
| *Corethron criophilum* | — | — | × | × | × | × | × | — | — | — | — | — | — | — | — |
| *Fragilariopsis antarctica* | — | — | — | — | — | × | × | × | — | × | — | × | — | × | — |
| *Fragilaria sublinearis* | × | — | — | — | — | — | — | × | — | — | — | — | — | — | — |
| *F. linearis* | × | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| *Synedra pelagica* | — | — | — | — | — | × | — | — | — | — | — | — | — | — | — |
| *Licmophora luxuriosa* | — | — | — | — | — | — | — | — | — | — | × | — | — | — | — |
| *L. Lyngbyei* | — | — | — | — | — | — | — | × | × | × | × | — | — | — | — |
| *Grammatophora kerguelensis* | — | — | — | — | — | — | — | — | — | × | — | — | — | — | — |
| *G. serpentina* | — | — | — | — | — | — | — | — | — | × | — | — | — | — | — |
| *Rhabdonema adriaticum* | — | — | — | — | — | — | — | — | — | — | — | — | — | — | × |
| *Entopyla kerguelensis* | — | — | — | — | — | — | — | × | — | × | — | — | — | — | — |
| *Achnanthes kerguelensis* | — | — | — | — | — | — | — | — | — | × | — | — | — | — | — |
| *Cocconeis ceticola* | — | × | — | — | — | — | — | — | — | — | — | — | — | — | — |
| *C. imperatrix* | — | — | — | — | — | — | — | × | — | × | — | — | — | — | × |
| *C. pinnata* | — | — | — | — | — | — | — | × | — | × | — | — | — | — | × |
| *Navicula corymbosa* | × | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| *N. lyra* | — | — | — | — | — | — | — | — | — | — | — | — | — | — | × |
| *N. subpolaris* | × | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| *Trachyneis aspera* | — | — | — | — | — | — | — | — | — | × | — | — | — | — | — |
| *Tropidoneis antarctica* | — | — | — | — | — | × ? | × | — | — | — | — | — | — | — | — |
| *T. belgicae* | × | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| *Pleurosigma directum* | — | — | — | — | — | — | — | × | — | — | — | — | — | — | — |
| *Amphiprora Oestrupii* | × | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| *Chuniella oceanica* | — | — | — | — | — | — | × | — | — | — | — | — | — | — | — |
| *Nitzschia Barbieri* | × | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| *N. closterium* | — | — | — | — | — | — | × | × | — | — | — | — | — | — | — |
| *N. pelagica* | — | — | — | — | — | — | × | × | — | — | — | — | — | — | — |
| *N. seriata* | — | — | — | — | — | — | × | × | — | — | — | — | — | × | × |

It would be very difficult to say how the chemical and physical factors of the water exert the influences that bring about these modifications. It is likely that the density of the water, which as shown in the table on p. 159 varies considerably from the tropics to the polar regions, might be responsible to a large degree.

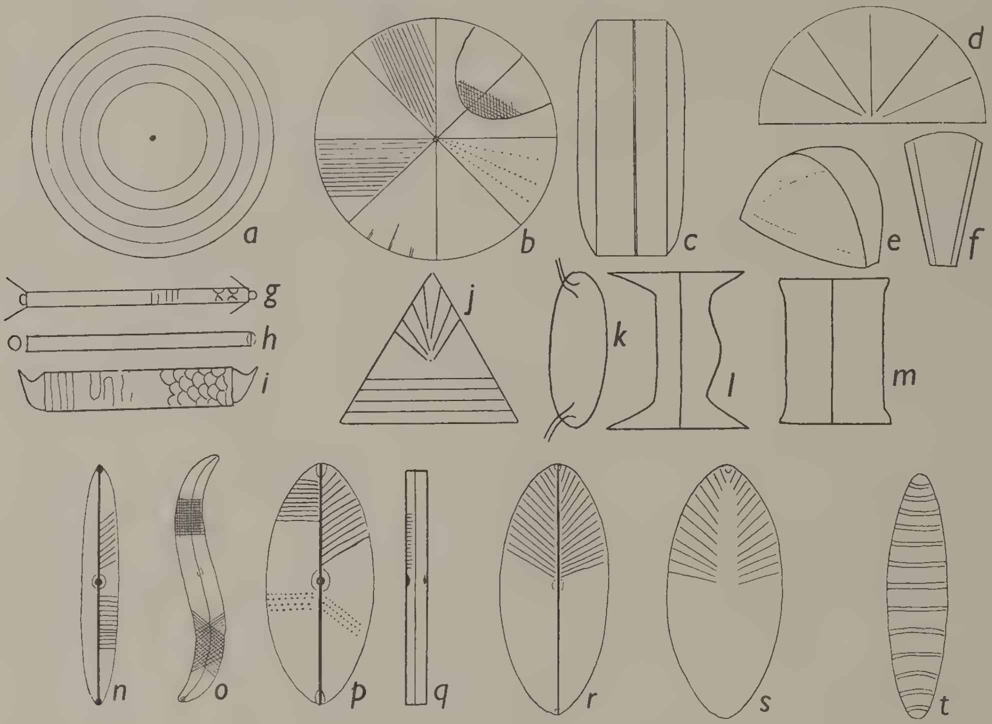

Fig. 3.

## ANALYTICAL KEY TO THE GENERA

The construction of a key is a matter of great difficulty in diatoms, because of the difficulty of finding adequate expression for the definitive characters, to make them comprehensible to the uninitiated, and because the size of the organisms does not allow their various aspects to be examined with ease. The following key is mainly for the field worker, based upon characters observed in fresh material or in material carefully preserved in formalin.

Great care must be taken in consulting section 1 of the key. In section 1 are included all the main divisions of the diatoms observed in the Antarctic. Section 1 is necessarily large, as the old division of diatoms into two groups, viz. Centricae and Pennatae, which is wholly inadequate in the case of plankton diatoms, has been abandoned, and the first section has been framed upon altogether different lines to include the genera of zygomorphic diatoms which form such a large part of the phytoplankton. Correct interpretation of the characters set out in section 1 will take the worker directly to the group of genera in which the genus he desires to identify is contained. After section 1 the key is dichotomous.

The illustrations in Fig. 3 are added to aid the verbal descriptions of section 1. They do not depict any given species, but are merely diagrammatic representations of types of structure.

1. Cells discoid in valve view, rectangular in girdle view, pervalvar axis seldom more than twice the diameter, valve structure arranged with reference to a central point, i.e. radiate or concentric or nearly so (Figs. *a*, *b*, *c*) ... ... ... ... ... ... ... 2
1. Cells cuneate in girdle view, segmental in valve view (Figs. *d*, *e*, *f*) ... ... ... ... 25
1. Cells tubular; pervalvar axis 4–20 times as long as the diameter; valve margin indefinite; valves circular or oval, usually hyaline; connective zone well developed, composed of annular segments or imbricate scales (Figs. *g*, *h*, *i*) ... ... ... ... ... ... 27
1. Cells angular in valve view, 2 or more angles; girdle view not narrowly rectangular, showing projections in the angles or corners (Figs. *j*, *k*, *l*, *m*) ... ... ... ... 33
1. Cells straight or sigmoid, with more or less bilateral symmetry about the apical axis in the valvar plane; valves linear, linear-lanceolate to broadly oval; girdle view rectangular (Fig. *q*); median area bearing a raphe, i.e. a true cleft in the apical axis, also central and polar nodules; valve markings arranged either at right angles to the raphe or subradiate about the central nodule (Figs. *n*, *o*, *p*, *q*) ... ... ... ... ... ... ... 44
1. Cells bearing raphe upon one valve and a pseudoraphe on the other (Figs. *r*, *s*) ... ... 53
1. Cells with a pseudoraphe upon both valves ... ... ... ... ... ... ... 55
1. Cells with neither raphe nor pseudoraphe; valves oval-lanceolate or linear-lanceolate; valve surface bearing transverse bars (Fig. *t*) ... ... ... ... ... ... 63
2. Valves with radial markings in the form of lines or furrows forming sectors ... ... 3
2. Radial markings punctate or areolate, sectors not formed by lines or furrows ... ... 7
3. Radial markings peripheral only, clearly not reaching the centre ... ... ... ... 4
3. Radial markings originating at the centre ... ... ... ... ... ... ... 6
4. Sectors alternately raised and depressed ... ... ... ... *Actinoptychus* (271)
4. Sectors in one plane ... ... ... ... ... ... ... ... ... ... 5
5. Radial markings furrowed, long; areolation concentric ... ... *Arachnoidiscus* (266)
5. Radial markings furrowed, short; areolation radial ... ... ... *Stictodiscus* (265)
6. Segments equal ... ... ... ... ... ... ... ... *Asterolampra* (267)
6. Segments unequal ... ... ... ... ... ... ... *Asteromphalus* (269)
7. Cells in colonies ... ... ... ... ... ... ... ... ... ... ... 8
7. Cells solitary ... ... ... ... ... ... ... ... ... ... ... 18
8. No direct contact between valve surfaces of adjacent cells; mucous communication only ... ... ... ... ... ... ... ... ... ... ... ... 9
8. Adjacent cells in contact, either by the valve surfaces or by horn-like processes from them ... ... ... ... ... ... ... ... ... ... ... ... 11
9. Cells aggregated to form mucous colonies of no definite shape ... *Thalassiosira* (237)
9. Cells united in chains by mucous threads ... ... ... ... ... ... ... 10
10. Mucous threads single ... ... ... ... ... ... ... *Thalassiosira* (237)
10. Mucous threads multiple ... ... ... ... ... ... *Coscinoscira* (*)
11. Cells united by marginal spines... ... ... ... ... ... ... ... ... 12
11. Cells united by valve surfaces ... ... ... ... ... ... ... ... ... 15

* *Coscinoscira*, *Detonula*, *Bacteriosira* and *Lithodesmium* have been included to make the key complete for all plankton genera.

| | | |
|---|---|---|
| 12. | Spines minute | 13 |
| 12. | Spines not shorter than half the pervalvar axis | 14 |
| 13. | Valves with central spine | *Schroderella* (241) |
| 13. | Central spine absent | *Detonula* (*) |
| 14. | Valve surface coarsely areolate | *Stephanopyxis* (236) |
| 14. | Valve surface hyaline | *Skeletonema* (236) |
| 15. | Valves punctate, radially furrowed | *Melosira* (234) |
| 15. | Valves hyaline | 16 |
| 16. | Valves with a corona of marginal spinulae | *Bacteriosira* (*) |
| 16. | Marginal processes one or two only | 17 |
| 17. | Marginal process one only, reduced to an apicule | *Lauderia* (240) |
| 17. | Marginal processes two, each bearing a small mucro | *Cerataulina* (279) |
| 18. | Cells with extra-valvar radial extensions | 19 |
| 18. | Cells without radial extensions | 20 |
| 19. | Valve surface areolate, extensions loculate | *Planktoniella* (257) |
| 19. | Valve surface hyaline, extensions spinous | *Gossleriella* (258) |
| 20. | Valves of each cell differing from one another | 21 |
| 20. | Cells with similar valves | 22 |
| 21. | Valve surface punctate, irregularly fasciculate | *Schimperiella* (256) |
| 21. | Valve with 6–10 punctate radial lines in each quadrant; other radial lines fine and numerous | *Charcotia* (256) |
| 22. | Valves each with a small marginal ocellus | *Actinocyclus* (259) |
| 22. | Valves without a marginal ocellus | 23 |
| 23. | Valves differentiated into two concentric zones by the scar of abscission | *Hyalodiscus* (235) |
| 23. | Valve surface not divided into zones | 24 |
| 24. | Pervalvar axis less than the diameter of the valve, areolation usually coarse | *Coscinodiscus* (242) |
| 24. | Pervalvar axis greater than the diameter of the valve, areolation extremely fine | *Ethmodiscus* (255) |
| 25. | Cells cuneate in girdle view, segmental in valve view, valve surface punctate | *Hemidiscus* (264) |
| 25. | Cells not cuneate in girdle view, or segmental in valve view | 26 |
| 26. | Cells tubular | 27 |
| 26. | Cells gonioid, angles produced, or differentiated | 33 |
| 27. | Cells with conical valves | *Rhizosolenia* (309) |
| 27. | Cells with flat or weakly convex valves | 28 |
| 28. | Valves with marginal corona of bristles | 29 |
| 28. | Valves without corona of bristles | 30 |
| 29. | Bristles bifurcate | *Bacteriastrum* (306) |
| 29. | Bristles not bifurcate | *Corethron* (325) |
| 30. | Intercalary bands of connective zone spirally arranged | *Dactyliosolen* (322) |
| 30. | Intercalary bands of zone not spirally arranged | 31 |
| 31. | Valves with marginal corona of small spines | *Schroderella* (241) |
| 31. | Valves without corona of spines | 32 |
| 32. | Valves flat with marginal spur | *Guinardia* (321) |
| 32. | Valves convex, marginal spur absent | *Leptocylindrus* (322) |
| 33. | Cells with two angles in valve view | 34 |
| 33. | Cells with more than two angles | 39 |

* See note on page 229.

34. Each angle of the cell bearing one long bristle ... *Chaetoceros* (289)

34. Angles of the cell bearing processes ... 35

35. Processes cornutate ... 36

35. Processes simple boss-like projections ... 37

36. Processes cornutate terminated with short spines ... *Hemiaulus* (285)

36. Processes cornutate without spines ... *Biddulphia* (273)

37. Cells in curved, ribbon-like chains; valve bearing a small eccentric spine ... *Eucampia* (285)

37. Cells in chains with a slight spiral twist ... 38

38. No intercellular spaces; cells weakly siliceous ... *Streptotheca* (287)

38. Intercellular spaces large and elliptical ... *Climacodium* (287)

39. Cells solitary ... 40

39. Cells united in chains ... 43

40. Valves with a long central spine ... *Ditylum* (284)

40. Valves without central process of any kind ... 41

41. Cells with projections or differentiated areas in the angles of the valves ... 42

41. Valve surface flat; no projection or differentiated area in the angles of the valves; several indistinct radial lines terminating in marginal apiculi ... *Pseudo-triceratium* (282)

42. Valve surfaces hexagonally areolate; areolation transverse; processes cornutate *Triceratium* (283)

42. Areolation radial; process a boss of fine pores ... *Trigonium* (280)

43. Connective zone continuous from cell to cell; valve surfaces contiguous ... *Bellerochea* (280)

43. Valve surfaces not contiguous ... *Lithodesmium* (*)

44. Cells with more or less bilateral symmetry upon the apical axis in the valvar plane, median area bearing a raphe, i.e. a true cleft upon each valve ... 45

44. Cells with raphe not in median area upon each valve ... 51

45. Cells in valve view linear to oval-lanceolate, axile area straight ... 46

45. Valves sigmoid, sublunate or spirally twisted ... 48

46. Cells with laminate valves ... *Trachyneis* (346)

46. Valves not laminate ... 47

47. Valve punctate, striation reaching margin of valve ... *Navicula* (343)

47. Striation not reaching valve margin, leaving hyaline lateral spaces ... *Scoresbya* (346)

48. Cells with sigmoid flexure ... *Pleurosigma* (347)

48. Cells sublunate or spirally twisted ... 49

49. Cells sublunate, raphe close to ventral margin of the cell ... *Amphora* (351)

49. Cells with torsion about apical axis ... 50

50. Cells with alate projections; zone complex; raphe sigmoid, not in the median line *Amphiprora* (349)

50. Raphe in the median line, straight in valve view, zone simple ... *Tropidoneis* (350)

51. Raphe carried upon an eccentric keel ... *Nitzschia* (351)

51. Cells without a true raphe upon each valve ... 52

52. Cells with raphe on one valve and pseudoraphe on the other ... 53

52. Cells without a true raphe upon either valve ... 54

53. Valves symmetrical about apical and transapical axes ... *Cocconeis* (341)

53. Valves asymmetrical about apical axis ... *Achnanthes* (340)

54. Cells with median pseudoraphe upon both valves ... 55

54. Cells without raphe or pseudoraphe ... 63

* See note on page 229.

55. Cells with internal septa in valvar plane, septa often perforated ... ... ... ... 56
55. Cells without septa ... ... ... ... ... ... ... ... ... ... 59

56. Valves broadly clavate, girdle cuneate ... ... ... ... ... ... *Licmophora* (337)
56. Valves not clavate ... ... ... ... ... ... ... ... ... ... 57

57. Cells concavo-convex in girdle view, septa 6–20 ... ... ... ... *Entopyla* (339)
57. Cells slightly biconvex or plane in girdle view ... ... ... ... ... ... 58

58. Cells in zigzag chains; septa 4–12, straight or nearly so ... ... *Rhabdonema* (339)
58. Septa wavy, usually 2 at each end of the cell ... ... ... ... *Grammatophora* (338)

59. Cells with bilateral symmetry about the transapical axis ... ... ... ... ... 60
59. Cells asymmetrical about the transapical axis ... ... ... ... ... ... ... 62

60. Cells in ribbon-like chains; valves usually linear ... ... ... ... *Fragilaria* (330)
60. Cells solitary ... ... ... ... ... ... ... ... ... ... ... 61

61. Cells with small terminal spines ... ... ... ... ... *Thalassionema* (336)
61. Cells without terminal spines ... ... ... ... ... ... ... *Synedra* (334)

62. Cells in stellate colonies, valves clavate ... ... ... ... ... *Asterionella* (333)
62. Cells solitary, spirally twisted, often in dense masses; one end of the cell inflated only a little
more than the other ... ... ... ... ... ... ... *Thalassiothrix* (335)

63. Cells in ribbon-like chains, valve surface bearing 7–12 transverse bars which alternate
with a double row of puncta ... ... ... ... ... ... *Fragilariopsis* (331)
63. Cells in zigzag chains, valve surface bearing usually 2–6 transverse bars, spaces between the
bars sometimes hyaline or with fine subradial punctation ... ... ... *Anaulus* (288)

## SYSTEMATIC ACCOUNT

The following arrangement includes all the species of diatoms that have been observed in the phytoplankton material examined. No attempt has been made to give an exhaustive list of references or to cite all the accepted synonyms. The references given include the original description of the species, while the others have been chosen because they provide excellent descriptions and illustrations or throw interesting light upon the history of the name now in use.

General observations regarding abundance or rarity, peculiarities of structure, appearance, or occurrence are included. Descriptions of the species are provided together with notes upon distribution and habit. Dimensions are expressed in *microns*, and are not intended as defining the limits of size of a species from any locality, but refer only to the specimens actually measured in carrying out this work. In order to give a more clear idea of the specimens examined, dimensions, particularly of diameter, are frequently expressed as two extremes, and that which was most frequent. For example: Diameter of valve 20–60$\mu$, mostly 52$\mu$, indicating that although specimens occurred as small as 20$\mu$ and as large as 60$\mu$ the majority of the specimens were actually 52$\mu$ in diameter.

Notes upon taxonomy and nomenclature are included in so far as they are of importance to the work in hand. Geographical distribution is indicated in general terms while the occurrence of a species is indicated by the station numbers, at which each species was observed. The station numbers afford reference to the Station List Discovery Reports, vols I, III and IV, where full particulars of locality, etc., will be found. The numbers of the stations taken by the 'Discovery II' are in sequence with those of the 'Discovery' and no letters are prefixed to them. Those taken by the 'William Scoresby' are distinguished by the letters WS, those taken in the Ross Sea by the 'C. A. Larsen' by RS, and those taken at the Marine Biological Station at South Georgia by MS.

# ALGAE

## Class BACILLARIOPHYCEAE

### Order BACILLARIALES

### Suborder DISCINEAE

### Family COSCINODISCACEAE

### Subfamily *MELOSIROIDEAE*

1. Cells in stiff chains, valve surface radially striate and furrowed ... ... ... *Melosira*
2. Cells solitary, valve surface radially striate, striation fine, central umbilical scar ... *Hyalodiscus*

### Subfamily *SKELETONEMOIDEAE*

1. Valve surface areolate, marginal spines unite cells into chains, intracellular distance short ... ... ... ... ... ... ... ... ... ... *Stephanopyxis*
2. Valve surface hyaline, marginal spines long, intracellular distance long ... *Skeletonema*
3. Valve surface hyaline, marginal spines short, denticulate, valve surfaces contiguous ... *Detonula*

### Subfamily *THALASSIOSIROIDEAE*

1. Cells in mucous colonies, or in chains, united by a single thread, cells distant ... *Thalassiosira*
2. Cells united by numerous mucous threads ... ... ... ... ... *Coscinoscira*
3. Cells united in chains, valves contiguous or nearly so, one marginal apicule... ... *Lauderia*
4. Cells united by marginal spinulae, each spinule producing 2 mucous threads, valve centre depressed, small central spine ... ... ... ... ... ... ... *Schroderella*

### Subfamily *COSCINODISCOIDEAE*

1. Cells solitary, striation fasciculate, marginal ocellus ... ... ... ... *Actinocyclus*
2. Marginal ocellus absent, valve surface areolate, peripheral extensions loculate *Planktoniella*
3. Valve surface hyaline, peripheral extensions spinous ... ... ... ... *Gossleriella*
4. Valves dissimilar, radially striate, one margin simple, the other striate ... ... *Charcotia*
5. Valves dissimilar, striation fasciculate, one margin loculate, the other striate ... *Schimperiella*
6. Valves similar, diameter of cell greater than pervalvar axis, valve surface punctate or areolate ... ... ... ... ... ... ... ... ... ... *Coscinodiscus*
7. Diameter of cell less than pervalvar axis, valve surface punctate ... ... *Ethmodiscus*

## Subfamily *MELOSIROIDEAE*

### Genus **Melosira** Agardh

Agardh 1824

The generic name was originally spelt *Meloseira.*

**Melosira polaris** Grunow.

Grunow. 1884, vol. XLVIII, p. 95, pl. E, fig. 33.
Hustedt, 1928, p. 273, fig. 116.

Cells discoid, united in short chains, valves flat or nearly so, radial furrows strongly marked, extending to one-third of the diameter of the valve, radial lines of fine pearls alternating with the furrows.

Diameter of valve 26–35μ, pervalvar axis 5–8μ.

This plant was observed in small numbers together with *Melosira sol* in the Bransfield Strait. A tychopelagic form, seldom in the plankton. This species has been observed in northern waters, but is not common, littoral.

Observed at St. WS 481.

**Melosira sol** (Ehrenberg) Kützing.

Kützing, 1849, p. 31.
Karsten, 1905, p. 70, pl. 1, figs. 3–9.
Hustedt, 1927, p. 270, fig. 115.
*Gallionella sol* Ehrenberg, 1844*b*, p. 202.

Cells discoid, strong, united to form chains, often of considerable length. Valves flat, or very weakly concave. Valves furnished with radial furrows occupying fully half the radius, peripheral zone finely striate, central area without structure. Margin of valve furnished with a single line of pores, girdle short, valve mantle finely striate, striae moniliform. Chromatophores: numerous flat plates. Diameter of valve 44–90μ, mostly 66μ; pervalvar axis 8–12μ.

A very variable species widely distributed throughout the temperate zone, although not frequently met with in English waters. Observed in fair numbers in the Bransfield Strait, and again off the Falkland Islands. A tychopelagic form.

Observed at Sts. WS 101, 481.

**Melosira sphaerica** Karsten.

Karsten, 1905, p. 70, pl. 1, fig. 2.
Mangin, 1915, p. 68, fig. 47.

Cells shortly cylindrical, valves circular, united to form short chains of some four to eight cells. Cells weakly siliceous, chains irregular, valves without any definite structure. Chromatophores: several small plates. Diameter of valve 54–65μ, mostly 60μ; pervalvar axis 60μ.

It is probable that this species is not a true *Melosira*. The cells are so weakly siliceous that when allowed to dry they collapse, and no satisfactory mounts can be made of them. A characteristic Antarctic form. A neritic diatom but never found in large quantities.

Observed at Sts. 305, 460, 501, 508, 509, 510, 575.

**Melosira sulcata** (Ehrenberg) Kützing.

Kützing, 1844, p. 55, pl. 2, fig. 7.
Hustedt, 1928, p. 276, fig. 119.
*Gallionella sulcata* Ehrenberg, 1838, p. 170, pl. 21, fig. 5.
*Orthosira marina* Wm Smith, 1856, p. 59, pl. 53, fig. 338.
*Paralia marina* Heiberg, 1863, p. 33.
*Orthosira sulcata* O'Meara, 1875–77, p. 252.

Cells discoid, often united together in long chains. Valves shaped like a plate, the central area slightly convex, valve mantles curved, bearing coarse granular markings, central area of valve face bearing short radial lines, which in some cases are reduced to a ring of irregular pearls. Chromatophores: numerous small plates. Diameter of valve 60–68$\mu$; pervalvar axis 7–8$\mu$.

Neritic and littoral, tychopelagic. Wide distribution in Arctic and European waters, was observed but rarely in Antarctic material.

Observed at St. 681.

## Genus **Hyalodiscus** Ehrenberg

Ehrenberg, 1845

**Hyalodiscus chromatoaster** Karsten.

Karsten, 1905, p. 74, pl. 2, figs. 4, 5.

Cells discoid, valves convex, sometimes deeply so. Central area of valve differentiated, furnished with fine granules irregularly arranged or scattered. Diameter of central area approximately half the total diameter of the valve. Peripheral zone finely striate, striae moniliform, oblique. Peripheral zone surrounded by finely striate margin, striae radial. Girdle composed of numerous annular segments. Chromatophores: numerous large stellate or lobed bodies. Diameter of valve 80–110$\mu$, mostly 95–100$\mu$; pervalvar axis 48$\mu$.

A bottom form frequently found in the plankton, neritic. A characteristic Antarctic diatom.

Observed at St. 482.

**Hyalodiscus kerguelensis** Karsten.

Karsten, 1905, p. 74, pl. 2, figs. 6, 7.

Cells discoid, valves somewhat deeply convex, central area of valve differentiated, furnished with fine and somewhat indistinct granules arranged irregularly or in radial lines. Diameter of the central area varies greatly, but is usually about half the total diameter of the valve. Peripheral zone finely striate, striae moniliform, radiate, granules in quincunx. Peripheral zone surrounded by a strong marginal flange, strongly striate. Girdle composed of numerous annular segments. Chromatophores: numerous spatulate or lobate bodies. Diameter of valve 95–145$\mu$, mostly 140$\mu$; pervalvar axis, usually 110$\mu$.

Although frequently found in the plankton this species must be regarded as a bottom form. It is very similar to *H. chromatoaster*, but usually a little larger and more robust. The chief differences lie in the form and arrangements of the chromatophores and in the orientation of the moniliform striae. A neritic diatom characteristic of Antarctic Seas.

Observed at St. 482.

**Hyalodiscus stelliger** Bailey.

Bailey, 1855, vol. VII, p. 10.
Lebour, 1930, p. 30, figs. 10, 11.

Cells discoid, valves strongly convex, finely striate, striae moniliform. Central area of valve strongly differentiated, peripheral zone striate, striae often parallel or nearly so, fasciculate. In central area, puncta few, irregularly arranged. Girdle composed of narrow intercalary bands. Chromatophores: numerous small plates. Diameter of valve 27–80μ; pervalvar axis 12–35μ.

Neritic and meroplanktonic, may be tychopelagic. Not common in the southern hemisphere, a few specimens only being observed off the Brazil coast. Widely distributed in northern waters and the Mediterranean Sea.

Observed at Sts. 719, 721.

### Subfamily *SKELETONEMOIDEAE*

### Genus Skeletonema Greville

Greville, 1865

**Skeletonema costatum** (Greville) Cleve.

Cleve, 1878, p. 18.
Lebour, 1930, p. 70, fig. 43.
Hustedt, 1928, p. 311, fig. 149.
*Melosira costata* Greville, 1866 *b*, p. 77.

Cells discoid, oblong or weakly spherical. Valves mostly convex, but sometimes almost flat. Cells united to form filaments by means of a marginal ring of long spines; spines straight, filaments straight, sometimes slightly spiral, weakly siliceous. Owing to the length of the spines the spaces between the individual cells are frequently larger than the cells themselves. The striation of the valves is extremely fine, if anything it is a little more pronounced upon the peripheral zone or valve mantle; but on the face of the valve it is almost invisible. Chromatophores: usually two small plates. Diameter of valve 8–15μ; pervalvar axis 4–12μ. Length of spines usually 6–10μ.

A very common pelagic diatom, frequently associated with a coastal flora, when present it is usually found in large numbers.

Observed at Sts. WS 593, 594, 598, 600, 601, 602, 644, 647, 649, 705, 709, 710.

### Genus Stephanopyxis Ehrenberg

Ehrenberg, 1844

**Stephanopyxis Palmeriana** (Greville) Grunow.

Grunow, 1884, p. 90.
Lebour, 1930, p. 74, fig. 47.

Hustedt, 1928, p. 308, fig. 147.
*Creswellia Palmeriana* Greville, 1865, p. 2, pl. 1, fig. 9.

Cells shortly cylindrical, oblong, forming long chains. Valves circular, convex, valve mantle or peripheral zone deep. Valve covered with hexagonal areolation, areoles large at the centre of the valve face, becoming increasingly smaller through the peripheral zone as they approach the valve edge. The two valves of the frustule adhere tightly by their edges. Valves furnished with a ring of stout spines; through each runs a fine, slightly spiral canal by means of which cytoplasmic continuity is maintained from cell to cell. Chromatophores: numerous small plates. Diameter of valve 70–110$\mu$; pervalvar axis 85$\mu$.

A pelagic diatom, favouring warm water of high salinity, common in Indian Ocean, particularly around South Africa. Found occasionally in the Mediterranean.

Observed at Sts. 425, 427, 428, 433, 434, 1373, 1575.

**Stephanopyxis turris** (Greville) Ralfs ex Pritchard.

Pritchard, 1861, p. 826, pl. 5, fig. 74.
Karsten, 1905, p. 73, pl. 2, fig. 1.
Lebour, 1930, p. 73, figs. 45–46.
Hustedt, 1928, p. 304, fig. 140.
*Creswellia Turris* Greville ex Gregory, 1857, p. 538, pl. 14, fig. 109.

Cells cylindrical, oblong, with rounded ends, united to form chains. Valves circular, strongly convex, peripheral zone very deep. Valve covered with strong and irregular areolation, areoles usually the same size on all parts of the valve. Peripheral zone or mantle usually longer than diameter of the valve. Valve frequently constricted in zonal view above point of suture, giving the valve a flanged or helmet appearance. Valve furnished with a concentric ring of stout spines as in *S. Palmeriana*. Chromatophores: numerous small plates. Diameter of valve 20–60$\mu$, mostly 52$\mu$; pervalvar axis 40–90$\mu$.

A pelagic diatom frequent in temperate seas, common off the Atlantic and Pacific coasts of America, rare in polar waters. Frequently found in tertiary fossil deposits both in New Zealand and Europe.

Observed at Sts. 261, 262, 435, 437, 722, 723; WS 593, 594, 647, 650, 709, 710, 712.

## Subfamily *THALASSIOSIROIDEAE*

### Genus **Thalassiosira** Cleve

Cleve, 1873

**Thalassiosira antarctica** Comber.

Comber, 1896, p. 491, pl. 11.

Cells discoid, united to form chains composed of three to twenty cells, or dense mucilaginous colonies. Valves circular, surface slightly convex. Valves furnished with somewhat coarse puncta, arranged in radiating and frequently bifurcate rows; central granules usually larger, sometimes spinous. Margin of valve furnished with numerous spinulae, small, often arranged in two irregular rows. Resting spores frequently observed, lenticular, hexagonally areolate, irregular, coarse. Numerous spinulae over the entire surface, marginal ones conspicuous. Chromatophores: several small plates. Diameter of valve 15–60$\mu$, mostly 44$\mu$; pervalvar axis mostly 30$\mu$.

A very variable species, widely distributed throughout Antarctic waters. This organism appears in Karsten (1905) as *Thal. antarctica* n.sp. No explanation is given for this, and it must be assumed that Karsten was unaware of Comber's paper.

Observed at Sts. 461, 478, 479, 481, 482, 501, 503, 504, 505, 506, 507, 508, 509, 510, 511, 513, 542, 543, 552, 553, 576, 577, 578, 580; WS 469, 474, 481, 545, 580; MS 86.

**Thalassiosira condensata** Cleve. (Pl. XI, figs. 11, 12.)

Cleve, 1900*a*, Bd. XXXIV, p. 22, pl. 8, figs. 12, 13.
Hustedt, 1928, p. 332, fig. 169.
Gran, 1905, p. 20, fig. 15.
Lebour, 1930, p. 63, fig. 35.

Cells shortly cylindrical, in girdle view rectangular. Valves circular, united to form chains by means of a short thread joining the centres of the valves. Central area of valve slightly depressed, valve without any visible structure with the exception of a small central pore from which is exuded the mucous thread. A single row of spinulae at the margin of the valve, sometimes produced as radiating gelatinous threads. Girdle composed of numerous intercalary bands. Chromatophores: numerous small plates. Diameter of valve 28–35$\mu$; pervalvar axis 20–33$\mu$.

As the identification of this species is somewhat difficult its distribution is uncertain. It has been recorded from the English Channel and from the coast of Norway. It must be considered as a temperate neritic species favouring a fairly high salinity. In the material examined, it was observed in the Peru Current, and also off the coast of South Africa, north of Cape Town.

Observed at Sts. 260, 261, 262, 1373; WS 703, 705.

**Thalassiosira decipiens** (Grunow ex Van Heurck) Jörgensen. (Pl. XI, fig. 9.)

Jörgensen, 1905, p. 96, pl. 6, fig. 3.
Hustedt, 1928, p. 322, fig. 158.
Gran, 1905, p. 17, fig. 10.
Lebour, 1930, p. 58, fig. 30.
*Coscinodiscus decipiens* Grunow ex Van Heurck, 1881.
*Thalassiosira gelatinosa* Hensen, 1887, p. 87.

Cells discoid, rectangular. Valves circular, united to form chains by means of a long central mucous thread. Spaces between individual cells usually three or four times the pervalvar distance. Valves slightly convex, furnished with areolate structure in curved lines similar to that of *Coscinodiscus excentricus*, areoles relatively large in the centre of the valve, decreasing as the peripheral zone is reached. Margin of valve furnished with a ring of strong slightly curved spinulae. Spinulae often produced as long mucous threads. Peripheral zone much deeper than in *C. excentricus*. Chromatophores: 12–20 small irregular plates, usually lying close to the valves. Diameter of valve 12–40$\mu$, mostly 32$\mu$; pervalvar axis 8–18$\mu$; intercellular thread 30–80$\mu$.

A neritic species, fairly common in temperate waters particularly in the northern hemisphere. Recorded from the Brazilian coast and from the Peru Current off the Chilean coast. This is the first record of this species in the Pacific Ocean.

Observed at Sts. 722, 723; WS 593, 647, 648, 649, 650.

**Thalassiosira gravida** Cleve. (Pl. XI, fig. 10.)

Cleve, 1896, vol. XXII, p. 12, pl. 2, figs. 14–16.
Hustedt, 1928, p. 325, fig. 161.
Gran, 1905, p. 18, fig. 12.
Lebour, 1930, p. 59, fig. 31.

Cells discoid, rectangular in girdle view. Valves circular, united to form chains by a thick mucous thread exuded from a central pore; thread short, but often undulating. Valves flat or nearly so, edges slightly rounded. Structure of the valve very faint, composed of radial striae, moniliform. Valves furnished with small spinulae irregularly disposed, and one fairly stout apicule, usually marginal. Resting spores were frequently observed, and are characterized by their strongly convex valves, convexity unequal, and large areolate structure. Chromatophores: ten to eighteen small plates, usually adhering to the valves. Diameter of valve 20–58$\mu$, mostly 50$\mu$; pervalvar axis 8–25$\mu$; intercellular thread 30–40$\mu$.

Distribution, temperate to subpolar, common in neritic plankton in all northern seas. Observed fairly frequently in plankton around South Georgia.

Observed at Sts. 508, 509, 510, 511, 512, 513.

**Thalassiosira hyalina** (Grunow) Gran.

Gran, 1897, p. 16, pl. 1, figs. 17, 18.
Gran, 1905, p. 17, fig. 11.
Hustedt, 1928, p. 323, fig. 159.
Lebour, 1930, p. 61, fig. 32.
*Coscinodiscus hyalinus* Grunow ex Cleve et Grunow, 1880, p. 113.

Cells discoid, narrowly rectangular. Valves circular, united to form chains by means of central mucous thread. Distances between frustules often unequal. Valves flat, with slightly rounded or bevelled edges. Valves furnished with fine moniliform striation; striae radial, structure best seen when the valves are mounted dry. A single row of small spinulae surround the margin of the valve, including one larger apicule. Chromatophores: usually eight to ten small plates. Diameter of valve 24–48$\mu$, mostly 40$\mu$; pervalvar axis about 10$\mu$; intercellular thread 6–10$\mu$ and 40–50$\mu$.

A neritic species which has been recorded only from northern waters, its occurrence therefore off the coast of South Africa is somewhat unusual, it had probably been carried north-eastwards from the neighbourhood of Bouvet Island.

Observed at Sts. 260, 262.

**Thalassiosira subtilis** (Ostenfeld) Gran.

Gran, 1900*a*, p. 117.
Ostenfeld, 1903, p. 563, fig. 119.

Hustedt, 1928, p. 330, fig. 166.
Lebour, 1930, p. 64, fig. 36.
*Podosira subtilis* Ostenfeld ex Ostenfeld et Knudsen (1899), p. 55.

Cells discoid, small, colonial, usually embedded in a gelatinous mass. Valves circular, convex. Girdle composed of annular segments. The surface of the valve is almost without structure, with the exception of a few extremely fine and isolated granules in the centre; at the margin is a ring of very small spinulae and one apicule. Chromatophores: eight to ten small plates. Diameter of valve 20–30$\mu$; pervalvar axis 10–15$\mu$.

An oceanic species very common in the Atlantic and Southern Oceans, sometimes found free, but mostly in enormous colonies embedded in a gelatinous film, very commonly mixed with *Corethron*. In the more southerly and colder waters the production of the gelatinous film was more frequent than in warmer waters.

Observed at Sts. 381, 434, 435, 436, 437, 438, 439, 512, 1373; WS 645, 705, 706, 709, 710, 711, 712, 713, 714.

### Genus **Lauderia** Cleve

Cleve, 1873

**Lauderia borealis** Gran.

Gran, 1900*a*, p. 110, pl. 9, figs. 5–9.
Hustedt, 1929, p. 549, fig. 313.
Lebour, 1930, p. 66, fig. 38.

Cells shortly cylindrical, irregularly rectangular in girdle view. Valves circular, united to form short chains. Cells weakly siliceous, valves slightly convex, with slight depressions in their centres. The margin of the valve is furnished with a number of extremely fine spines, which are visible only if the specimens are examined when mounted dry; an indistinct apicule is also present. Peripheral zone of valve covered with fine areolate punctation. Girdle composed of annular segments, which as a rule are seen only when the specimen is mounted dry. Chromatophores: numerous small irregularly rectangular plates. Diameter of valve 40–48$\mu$; pervalvar axis 45$\mu$.

An oceanic diatom which favours warm water of a high salinity: common in Indian Ocean, it has been reported from the Mediterranean, but seldom is found in the northern hemisphere.

Observed at St. 1373.

**Lauderia punctata** Karsten.

Karsten, 1907, p. 374, pl. 42, fig. 7.

Cells cylindrical, usually three times longer than broad, united by mucous threads to form straight chains. Valves circular, almost touching each other, having a median depression, and rounded margin. Margin furnished with spinulae. Girdle composed of annular segments, bearing moniliform striation, puncta arranged in quincunx. Chromatophores: numerous vermiform bodies. Diameter of valve 20–34$\mu$, mostly 30$\mu$; pervalvar axis mostly 90$\mu$.

This species was observed off the coast of South Africa and in the Peru Current off the Chilean coast, but never occurred in great numbers. A neritic species confined to temperate waters; it has not been recorded in the northern hemisphere.

Observed at Sts. 425, 427, 428, 433, 434, 436; WS 709, 710, 714, 715.

### Genus Schroderella Pavillard

Pavillard, 1913

**Schroderella delicatula** (Peragallo) Pavillard.

Pavillard, 1913, p. 126.
Pavillard, 1925, p. 22, fig. 33.
Lebour, 1930, p. 68, fig. 40.
Hustedt, 1929, p. 551, fig. 314.
*Lauderia delicatula* Peragallo, H., 1888, p. 89, pl. 6, fig. 46.
*Detonula delicatula* Gran, 1900*a*, p. 112.

Cells cylindrical, elongated about the principal axis. Valves circular more or less convex, but mostly flat, with short, sharply curved peripheral zones. Centre of valve depressed, furnished with short central spine, often united to form chains. Margin of valve furnished with a row of short sharp spines, which interlock with those of the neighbouring frustules. Valve almost without structure. Girdle composed of annular segments which are finely areolate. Chromatophores: numerous small rectangular or stellate plates. Diameter of valve 20–35$\mu$; pervalvar axis up to 110$\mu$.

A neritic species, very common around South Africa. It favours warm water of fairly low salinity, has been recorded from the Atlantic, west coast of Africa and the Mediterranean.

Observed at Sts. 425, 427, 428, 434, 435, 437, 438, 439, 1373.

**Schroderella Schroderi** (Bergon) Pavillard.

Pavillard, 1925, p. 23, fig. 33.
Lebour, 1930, p. 68, fig. 41.
*Lauderia Schroderi* Bergon, 1902*b*, p. 69.

Cells shortly cylindrical or oblong, united to form loose chains. Valves circular, convex, centrally depressed, furnished with a central spine. Valves almost devoid of definite structure, but the margins are furnished with rows of well-developed spines. Girdle composed of annular segments, finely areolate. This species is very close to the foregoing one, Hustedt (1929) unites them. Here they are regarded as being separate on the grounds that *S. Schroderi* is usually greater in diameter and less in pervalvar axis than *S. delicatula*, and that the spaces between the cells are well marked and the spines more prominently developed in the former. Further, generally speaking *S. Schroderi* favours colder water. A neritic species. Chromatophores: numerous small angular plates. Diameter of valve 20–55$\mu$; pervalvar axis 18–40$\mu$.

Distribution is very difficult to define, as it probably has been much confused with the previous species. A northern form, reported from the Atlantic Ocean, and English Channel. It was found to be fairly abundant in the Peru Current material.

Observed at Sts. 434, 436, 1373; WS 593, 594, 640, 665, 666, 705, 709, 710.

## Subfamily *COSCINODISCOIDEAE*

### Genus Coscinodiscus Ehrenberg

Ehrenberg, 1838

### INORDINATAE Rattray

**Coscinodiscus nitidus** Gregory.

Gregory, 1857, p. 499, pl. 10, fig. 45.
Karsten, 1905, p. 84, pl. 7, fig. 1.
Hustedt, 1928, p. 414, fig. 221.

Cells discoid, small. Valves flat or nearly so. Valves covered with somewhat large granules, showing an irregular radial arrangement. Granules sparse, rounded, large in the centre of the valve, decreasing in size as they approach the periphery. Margin of the valve furnished with short radial lines of small puncta, three to four puncta in each line. Chromatophores: several irregular plate-like bodies. Diameter of valve 58$\mu$.

A well-marked species fairly common around European coasts, but was observed at one Station only off South Georgia. Meroplanktonic, probably a bottom form.

Observed at St. 479.

### EXCENTRICAE Rattray

**Coscinodiscus excentricus** Ehrenberg.

Ehrenberg, 1840*a*, p. 146.
Gran, 1905, p. 29.
Hustedt, 1928, p. 388, fig. 201.
Lebour, 1930, p. 36, fig. 13.
*Coscinodiscus labyrinthus* Roper, 1858, p. 21, pl. 3, fig. 2.
*Coscinodiscus heliozoides* Siddall, 1912, p. 377, pl. 3.

Cells discoid, small, solitary. Valves flat or nearly so. Valves covered with strong hexagonal areolation, in ill defined sectors of curved and somewhat parallel lines, but often tangential. Sectors usually seven, but may be six or eight. Central areoles usually larger than peripheral ones. Margin of valve furnished with a number of stout but short apiculae. Siddall (1912), noticed in fresh material gathered at Bournemouth, a number of radiating protoplasmic threads proceeding from the valves, and upon this feature created a new species, *C. heliozoides*. This phenomenon is, however, of no specific importance, and is to be observed in many species of the Coscinodiscaceae when fresh. Chromatophores: several small flat plates. Diameter of valve 40–140$\mu$, mostly 100$\mu$; pervalvar axis 30$\mu$.

A widely distributed species showing much variation. Specimens from around the Cape of Good Hope were unusually large.

Observed at Sts. 386, 434, 451, 501, 679, 671.

### LINEATAE Rattray

**Coscinodiscus lineatus** Ehrenberg.

Ehrenberg, 1839, p. 129.
Hustedt, 1928, p. 392, fig. 204.

Karsten, 1905, p. 80, pl. 8, fig. 2.
Lebour, 1930, p. 37, fig. 14.
Gran, 1905, p. 30, fig. 30.
*Coscinodiscus Ehrenbergii* O'Meara, 1875–77, p. 264, pl. 26, fig. 24.
*Coscinodiscus leptopus* Grunow ex Van Heurck, 1880–5, pl. 131, fig. 5.

Cells discoid, solitary, strong. Valves usually flat but sometimes weakly convex. Valves covered with polygonal areolation arranged in tangential lines based upon six sectors. Areolae slightly smaller at the margin than in the central area of the valve. Margin strong, sometimes broad, radially striate, furnished upon the inner edge with a row of stout spinulae. Chromatophores; numerous plate-like bodies. Diameter of valve 44–120μ.

This species has a world-wide distribution in temperate and subtropical seas, and although a truly neritic diatom, is observed sometimes in oceanic plankton. The valves show much variation in diameter and coarseness of areolation. Species from cold waters are usually considerably smaller than those from warm seas.

Observed at Sts. 263, 264, 340, 368, 369, 379, 380, 381, 382, 383, 384, 388, 440, 450, 659, 666, 1373, 1575.

### STELLATAE Rattray

**Coscinodiscus stellaris** Roper.

Roper, 1858, vol. VI, p. 21, pl. 3, fig. 3.
Gran, 1905, p. 37, fig. 40.
Karsten, 1905, p. 84, pl. 4, fig. 6.
Hustedt, 1928, p. 396, fig. 207.
Lebour, 1930, p. 49, pl. 1, fig. 4.
*Coscinodiscus stellaris* var. *fasciculata* Castracane, 1886.

Cells discoid, solitary. Valves convex, although often flattened in the middle. Valves covered with very fine areolation; areoles almost uniform in size throughout the whole valve surface, slightly decreasing towards the margin. Centre of valve furnished with a number of thickenings, usually three to six, arranged in a star-like pattern. Marginal spinulae and apiculi absent. Girdle usually narrow, simple, finely striate. Chromatophores: numerous small rounded bodies. Diameter of valve 80–130μ.

An oceanic *Coscinodiscus*, widely distributed throughout the Southern Ocean, equally common in the northern hemisphere. It occurred frequently around South Georgia, but was never observed in great numbers.

Observed at Sts. 302, 304, 305, 542, 543, 544, 551, 552, 553, 615, 617, 619; WS 481.

### RADIATAE Rattray

**Coscinodiscus Asteromphalus** Ehrenberg.

Ehrenberg, 1844, p. 77.
Hustedt, 1928, p. 452, fig. 250.
*Coscinodiscus Asteromphalus* var. *conspicua* Grunow ex Van Heurck, 1881–5, pl. 130, figs. 1, 2.

Cells discoid, large, solitary. Valves slightly convex. Valve surface covered with a strong areolation. A large central rosette enclosing a small structureless area. Areoles polygonal; outside the central rosette for a short distance along the radius the areoles are somewhat small, becoming larger, until at a distance equal to half the radius, they attain their maximum size after which they again decrease. Areoles furnished with characteristic secondary and tertiary structure. Chromatophores: numerous large rounded plates. Diameter of valve 230–360μ, mostly 330μ.

It is remarkable that this diatom was observed only in the material from the Pacific Ocean. It has a wide distribution in almost all temperate seas, but seldom occurs in great numbers. A neritic diatom, favouring a fairly high salinity.

Observed at Sts. WS 622, 623, 644, 645, 666.

**Coscinodiscus beta** Karsten.

Karsten, 1907, p. 362, pl. 36, fig. 1.

Cells discoid, small, solitary, almost flat but sometimes weakly convex. Valves covered with fine radial punctation. Margin of valve furnished with a circlet of short erect spines or horns. Chromatophores: small oval or roundish plates, few in number. Diameter of valve 92–100μ.

This form was first described by Karsten from Indian Ocean material collected in tropical waters. The specimens here described were collected to the south of Madagascar and appeared to be slightly larger and more robust than the type specimen. The species is not common and has not been recorded outside the Indian Ocean. It is never found in large numbers.

Observed at St. 440.

**Coscinodiscus bouvet** Karsten. (Pl. XIII, figs. 3, 4.)

Karsten, 1905, p. 83, pl. 3, fig. 9.
Heiden and Kolbe, 1928, p. 495.
Mangin, 1915, p. 52, fig. 36.

Cells circular in valve view, octagonal in girdle view, medium to large, sometimes solitary but usually in short chains of two to four frustules. The formation of the valve is characteristic and somewhat peculiar. The central area of the valve, equal to about one-third of the total diameter, but often less, is flat or nearly so; the peripheral area usually falls sharply down to the girdle, producing a characteristic octagonal pervalvar section. Sometimes the peripheral area falls in an undulating manner. Often the central areas of the two valves of the same frustule are of different diameters, that is one valve of the frustule may be more deeply conical than the other. Surface of valve covered with a fine hexagonal areolation; central rosette of cells regular and strongly marked; the areoles decrease in size as they approach the margin of the valve. Valve margin furnished with small spinulae. Girdle broad, usually bearing a number of lines. Chromatophores: numerous irregular stellate bodies, usually confined to the centre of the frustule or lying along the girdle. Diameter of valve 140–200μ (total), 40–70μ (central area); pervalvar axis 144–180μ.

This very handsome diatom is characteristic of Antarctic waters, and has a wide distribution in the southern seas. It is commonly met with around South Georgia, the

Sandwich Group and in the Bransfield Strait, sometimes in great numbers. It has been recorded from around the Cape of Good Hope, but is seldom met with north of latitude 40° S. A neritic diatom favouring cold water with fairly high salinity. It has not been recorded from the northern hemisphere.

Observed at Sts. 463, 475, 478, 509, 542, 544, 551, 664; WS 481.

**Coscinodiscus centralis** Ehrenberg.

Ehrenberg, 1839, p. 129.
Gran, 1905, p. 33, fig. 33.
Lebour, 1930, p. 39, figs. 16–18.
*Coscinodiscus asteromphalus* var. *centralis* Grunow, 1884, p. 79.
*Coscinodiscus oculus-Iridis* var. *tenuistriata* Grunow, 1884, p. 77.

Cells discoid, valves gently convex. Valves covered with radial areolation. Central rosette distinct, sometimes strongly marked, the areoles decreasing in size as they proceed to the periphery. Margin of valve furnished with a row of small spinulae, five to six areoles between each spinule. Margin also furnished with two small apiculi, usually situated at an angle of 90–95°. Girdle usually narrow, composed of several intercalary bands. Chromatophores: numerous small plates. Diameter of valve 160–210$\mu$, mostly 200$\mu$; pervalvar axis 50–60$\mu$.

A temperate species with a world-wide distribution, very common around South Georgia in the spring and summer. Generally regarded as an oceanic species.

Observed at Sts. 507, 670, 719, 721; WS 647; MS 86, 88, 89, 90, 92, 94, 95, 97, 98, 99, 100, 101, 102, 103.

**Coscinodiscus concinnus** Wm Smith.

Smith, 1856, p. 85.
Lebour, 1930, p. 43, fig. 19.
Hustedt, 1928, p. 441, figs. 241, 242.

Cells large, circular in valve view, almost rectangular in girdle view. Valve slightly convex, often slightly flattened at the centre. Valve surface covered with very fine areolation. Central rosette large, but often inconspicuous, the areolae decreasing in size as they proceed to the margin. Margin of valve furnished with fine spinulae, from which hyaline ribs or lines proceed to the centre of the valve. Two small but distinct apicules are situated asymmetrically on the valve margin. The pervalvar axis is often equal to the diameter of the valve and the girdle is composed of numerous intercalary bands. A weakly siliceous diatom, which collapses on drying. Chromatophores: numerous small rounded bodies. Diameter of valve 380–465$\mu$, mostly 460$\mu$; pervalvar axis usually 440$\mu$.

A neritic diatom, common in temperate and subtropical seas.

Observed at Sts. 1373, 1575.

**Coscinodiscus decrescens** Grunow in Schmidt.

Grunow (in A. Schmidt's Atlas) (1878) pl. 61, figs. 7–10.
Karsten, 1905, p. 87, pl. 8, fig. 1.
Hustedt, 1928, p. 430, fig. 233.

Cells discoid, solitary, small, valves convex, furnished with strong, subpolygona areolation. Areoles large in the centre, decreasing in size as they approach the margin, central area or rosette absent. Chromatophores: few irregular plates. Diameter of valve, 60–68μ.

Not a common diatom, more frequent in European waters than in Antarctic. Observed occasionally in plankton around South Georgia, neritic.

Observed at Sts. 475, 477, 479, 507.

**Coscinodiscus eta** Karsten.

Karsten, 1907, p. 366, pl. 37, fig. 3.

Cells discoid, solitary, slightly convex, large. Valves covered with very fine lines of puncta, central area or rosette absent. Puncta arranged in quincunx, lines radial. Chromatophores: numerous small rounded bodies. Diameter of valve, 130–170μ.

A tropical diatom usually found in the Indian Ocean; it has not been recorded previously from South Atlantic waters. It was observed in small numbers only at one station off South Georgia.

Observed at St. 478.

**Coscinodiscus gigas** Ehrenberg.

Ehrenberg, 1843, p. 412.
Karsten, 1907, p. 367, pl. 35, fig. 7.
Hustedt, 1928, p. 456, fig. 254.

Cells discoid, very large, weakly siliceous. Valves flat, covered with radial areolation, the areoles increasing in size as they approach the periphery. The areolation breaks down in the centre of the valve to form a large irregular stellate hyaline area. Areoles furnished with secondary structure, particularly those near the margin of the valve. Chromatophores: numerous small rounded bodies. Diameter of valve 300–500μ, mostly 450μ.

A large weakly siliceous diatom, oceanic, having a wide distribution in tropical and subtropical seas. Its occurrence in narrow belts of water suggests that it is susceptible to slight changes of salinity. It appears to favour a high salinity. It occurred commonly, but never in great numbers, all around the coast of South Africa, and again but less frequently off the coast of Brazil.

Observed at Sts. 260, 261, 262, 721, 722, 723, 1373; WS 709, 710.

**Coscinodiscus Grani** Gough. (Pl. XIII, fig. 2.)

Gough, 1905, p. 338.
Hustedt, 1928, p. 436, fig. 237.
Gran, 1905, p. 34, fig. 35.
Lebour, 1930, p. 44, fig. 20.

Cells discoid in valve view, cuneiform in girdle view. Valves covered with fine areolation, having a central rosette. Areoles in radial lines, large at the centre of the valve, decreasing in size as they approach the margin. Margin of valve furnished with a ring of fine spinulae, from which fine hyaline lines proceed to the centre of the valve.

Girdle cuneate, valve often shows greater convexity at a point other than the centre, usually towards the side upon which the girdle band is widest. Valve furnished with two asymmetrically placed processes, or apiculi. Chromatophores: numerous oval or rounded bodies. Diameter of valve 100μ; girdle, wide end 20μ, narrow end 10μ.

This diatom is frequent in the North Sea, and most northern European waters. It has been recorded from the English Channel, and has apparently spread into the Atlantic. It was observed at two stations off South-West Africa, but not in great numbers. The eccentricity of the convexity of the valves was not nearly so marked as that illustrated by Hustedt (1928) and Lebour (1930), but resembled more closely that illustrated by Gough (1905).

Observed at Sts. 263, 264.

**Coscinodiscus intermittens** Karsten.

Karsten, 1906, p. 156, pl. 26, fig. 14.

Cells discoid, solitary. Valves slightly convex, but often quite flat in the centre. Valves covered with fairly coarse puncta arranged in radial lines. A small cluster of usually seven to ten granules occupies the centre of the valve; these are surrounded by a hyaline space. Many of the radial lines of granules fail to reach the centre, giving rise to a number of interstitial hyaline spaces and a false fasciculate appearance. Puncta are of uniform size throughout the whole valve surface with the exception of those at the margin. Marginal puncta very small, forming close radial lines of six or eight puncta in each. Margin of valve furnished with small but prominent spinulae. Girdle simple, punctate. Chromatophores: numerous small cocciform bodies. Diameter of valve 90–110μ.

A handsome species found only in the Southern Ocean. Neritic, observed only in moderate numbers.

Observed at St. 440.

**Coscinodiscus kerguelensis** Karsten.

Karsten, 1905, p. 83, pl. 3, fig. 7.

Cells discoid, solitary, large. Valves convex, nearly flat at the centre, but with considerable valve mantle. Valves covered with fine punctation radially arranged. Puncta in central area of valve smaller than those in the peripheral area and more closely arranged. Central area also traversed by secondary line system, imparting to that area an appearance of definite demarcation. Margin of valve strong, clearly marked with small closely packed radial lines. The whole surface of the valve is covered by occasional darker dots arranged in irregular radial lines, which appear to be superimposed upon the primary structure. Chromatophores: numerous small rounded or oval bodies. Diameter of valve 100–180μ, usually 165μ; pervalvar axis 80μ.

A large and handsome species found only in the Antarctic Ocean, and observed in considerable numbers in the Bransfield Strait. A meroplanktonic form, not often observed in the plankton, probably epiphytic upon larger algae.

Observed at St. WS 481.

**Coscinodiscus lentiginosus** Janisch in Schmidt.

Janisch (in Schmidt's Atlas), 1878, p. 58, fig. 11.
Castracane, 1886, p. 160, pl. 5, fig. 4.
Karsten, 1906, p. 155, pl. 26 *m*, fig. 11.

Cells discoid, solitary, small. Valves nearly flat, margin strong. Valve surface covered with granules which are somewhat irregularly disposed throughout the central area of the valve, but arranged in short radial lines, somewhat closely packed toward the valve margin. Between the radial lines and the margin of the valve is a narrow hyaline space which completely encircles the punctate portion. Margin strong, narrow, finely radially striate, furnished with one apiculus. Chromatophores: several large irregular bodies. Diameter of cell 40–120μ.

Type locality, Antarctic Ocean. A characteristic Antarctic diatom, widely spread throughout the South Atlantic.

An examination of the deep-sea ooze from the vicinity of Tristan d'Acunha showed that an enormous deposit of diatomaceous material was being formed which consisted very largely of this species.

Observed at Sts. 383, 384, 453, 475, 477, 482, 502, 504, 508, 570, 575–577; WS 545, 548–552A.

**Coscinodiscus marginatus** Ehrenberg.

Ehrenberg, 1843 *b*, p. 412.
Hustedt, 1928, p. 416, fig. 223.
*Coscinodiscus limbatus* Ehrenberg, 1840 *b*.
*Coscinodiscus fimbriatus-limbatus* Ehrenberg, 1854.

Cells discoid, solitary, strong. Valves flat or nearly so, particularly at the centre. Valves covered with strong and large areolation, areoles polygonal, central hyaline area absent. Areoles arranged somewhat irregularly radial, attaining their maximum size at about half the radius of the valve; peripheral areoles smaller. Valve surrounded by a broad flat margin, strongly striate radially. The areoles of the valves present a complex structure, showing an internal and lower chamber, surrounded by a ring of fine poroids. Chromatophores: several small rounded bodies. Diameter of valve 44–80μ.

This species is common in all temperate seas, but was not observed in great numbers. Probably a bottom form, meroplanktonic, but sometimes observed a considerable distance from land.

Observed at Sts. 675, 677, 1586.

**Coscinodiscus nodulifer** Janisch in Schmidt.

Janisch (in Schmidt's Atlas), 1878, pl. 59, figs. 21–23.
Karsten, 1907, p. 364, pl. 36, fig. 6.
Hustedt, 1928, p. 426, fig. 229.

Cells discoid, solitary. Valves flat or weakly convex, covered with strong polygonal areolation. The areoles attain their maximum size at about half the radius of the valve, after which they decrease. The areolation often breaks down at the centre to form a small hyaline or structureless area. By the side of this central area is a short, stout process, or nodule. The areoles present a complex secondary structure indicating an internal chamber furnished with poroids. Margin of valve small or narrow, radially striate. Diameter of valve 100μ.

This species was observed at one station only, off the South African coast, probably meroplanktonic, never in great numbers.

Observed at St. 434.

**Coscinodiscus oculoides** Karsten.

Karsten, 1905, p. 81, pl. 6, fig. 3.
Van Heurck, 1909, p. 49, pl. 12, fig. 167.

Cells discoid, solitary, medium to large. Valves convex, somewhat flattened towards the centre. Valves covered with hexagonal areolation, arranged somewhat radially. Areoles fairly uniform in size throughout the greater part of the valve surface, but decreasing in size gradually in the peripheral zone and upon the short valve mantle. Central area and rosette absent. A small dot may be observed in the centre of each areolation. Girdle simple, punctate, puncta in straight lines. Chromatophores: several small rounded, or somewhat flattened plate-like bodies. Diameter of valve 140–200μ, mostly 188μ.

This species bears some resemblance to *Coscinodiscus oculus-Iridis*, but has an Antarctic distribution only. A well-marked species, widely distributed throughout the Southern Ocean, most probably neritic, but sometimes observed in oceanic plankton.

Observed at Sts. 382, 452, 453, 480, 481, 482, 659, 661, 663, 664.

**Coscinodiscus oculus-Iridis** Ehrenberg.

Ehrenberg, 1840*a*, p. 147.
Hustedt, 1928, p. 454, fig. 252.

Cells discoid, solitary, large. Valves mostly flat or weakly convex. Valves covered with large polygonal areolation, arranged in radiating lines, the lines long and short. Central rosette often large, consisting usually of five areoles, sometimes less. Areoles small at the centre of the valve, increasing gradually in size as they proceed to the periphery. Peripheral areoles usually much smaller. The areoles present secondary and tertiary structure, in the form of an inner chamber and associated poroids. The opening of the inner chamber provides that characteristic appearance known as the "eye-spot". Girdle minutely punctate. Chromatophores: numerous rounded bodies. Diameter of valve 180–260μ.

Probably an oceanic species, but in the material examined it was always found as a meroplanktonic form. Frequent around the coast of South Georgia.

Observed at Sts. 425, 508, 677; MS 94, 95, 97, 98, 100, 101, 102, 103.

**Coscinodiscus oppositus** Karsten.

Karsten, 1905, p. 82, pl. 7, fig. 5.

Cells discoid, solitary, small. Valves flat. Valves covered with radiating lines of small puncta. Striae not very close together, simple; central hyaline space absent. Puncta of uniform size throughout the whole valve surface. Margin furnished with a ring of stronger puncta, or small, short spinulae. Two distinct ribs or lines oppose each other in a marginal position; ribs radial, often strongly marked. Girdle simple, minutely punctate. Chromatophores: few angular or rounded bodies. Diameter of valves 46–52μ.

A small Antarctic species seldom found in large numbers, widely distributed throughout the Southern Ocean, probably oceanic.

Observed at Sts. 453, 666.

**Coscinodiscus radiatus** Ehrenberg.

Ehrenberg, 1840*a*, p. 148, pl. 3, fig. 1.
Hustedt, 1928, p. 420, fig. 225.
Lebour, 1930, p. 39, fig. 15.
*Coscinodiscus borealis* Ehrenberg, 1862.

Cells discoid, solitary, small to medium, thin. Valves mostly flat. Valves covered with strong polygonal areolation, areolation entire, central hyaline area or rosette absent. Areoles in radiating lines, lines long and short. Areoles usually of uniform size throughout the whole valve surface, except at the margin, where they are much smaller. Girdle simple, narrow, striate. Spinulae and apiculi absent. Chromatophores: numerous cocciform bodies, often in clusters. Diameter of valve 70–140μ, mostly 100μ.

An oceanic species having a world-wide distribution in temperate seas, which often shows much variation in size, and coarseness of markings. Observed frequently off the coasts of South Africa and often in large numbers in the Peru Current off the west coast of South America. The latter appeared to be more robust.

Observed at Sts. 260, 261, 262, 263, 379, 424, 425, 434, 436, 438, 439, 450, 460, 475, 575, 670, 671, 673, 681, 722, 723, 1583; WS 481, 641, 646, 647, 648, 649, 700, 703.

**Coscinodiscus sub-bulliens** Jörgensen.

Jörgensen, 1905, p. 94, pl. 6, fig. 2.

Cells discoid, valves clearly convex, with an evenly rising marginal zone. The central area of the valve somewhat depressed, often flat. Valve surface covered with polygonal areolations, no central space. No distinct central rosette of areoles usually present, but an irregular grouping of five or six larger cells in the centre is common on larger specimens. The areoles usually increase in size from the centre of the valve to about half the radius, where they are largest, after which they suddenly decrease in size, but not progressively so, out to the periphery. Even in the area where the areoles are largest, a few small ones are often interspersed. Areolate structure irregularly dichotomously radiate. Margin furnished with small spinulae, and two larger apiculi, asymmetrically placed at an angle approaching 180°. Girdle usually formed of a few intercalary bands. Chromatophores: several large flattened bodies. Diameter of valve 90–250μ, mostly 200μ; pervalvar axis 70–80μ.

This species is often confused with *Coscinodiscus centralis*, and is often found associating with it. It has a sub-polar distribution, and has not been previously reported from the Antarctic. It was found in large numbers around the South Sandwich Group.

Observed at Sts. 365, 368, 369; WS 100, 481.

**Coscinodiscus tumidus** Janisch in Schmidt.

Janisch (in Schmidt's Atlas), 1886, pl. 59, figs. 38–39.
Karsten, 1905, p. 80, pl. 6, fig. 1.

Cells discoid. Valves convex, but often flattened in the centre. Valves covered with hexagonal areolation; areolation entire, central area and rosette absent. The areoles increase gradually in size as they proceed to the periphery. Margin of valve usually strong, sometimes wide, radially striate. Spinulae and apiculi absent. Girdle simple, striate. Chromatophores: numerous irregular rounded bodies. Diameter of valve 100–140μ.

Observed at one station only on the 30th W meridian at St. 664.

### FASCICULATAE Rattray

**Coscinodiscus Charcotii** M. Peragallo.

Peragallo, M., 1921, p. 81, pl. 6, fig. 4.

Cells discoid, somewhat small. Valves deeply convex with the central area slightly flattened. Valve surface covered with fascicules of areoles in straight lines which radiate from a central rosette of large areoles. The areoles decrease in size gradually as they proceed to the margin of the valve. The actual margin of the valve is very narrow and bears a ring of minute puncta. This species is characterized by the extreme dimensions of the central areoles. Often they are five or six times as large as the areoles that occupy the remainder of the valve surface. Diameter of cell 60–68μ.

Type locality: Argentine Islands, on the Pacific side of the Graham Land Peninsula.

This species was observed in the South Atlantic only at St. 677.

**Coscinodiscus Chunii** Karsten.

Karsten, 1905, p. 86, pl. 7, fig. 10.

Cells discoid, solitary, valves slightly convex. Valves covered with fine but strong areolation, in distinct radiating fascicules. Areolation very fine at the centre of the valve, becoming larger towards the periphery. Margin of valve furnished with a number, usually six to eight, of elongated marks, which may be formed either by the breaking down of the walls of adjacent cells, or by the production of a short rib. Chromatophores: numerous small irregular bodies. Diameter of valve 120–140μ.

Observed at Sts. 475, 477, 478.

**Coscinodiscus curvatulus** Grunow in Schmidt.

Grunow (in Schmidt's Atlas), 1878, pl. 57, fig. 33.
Hustedt, 1928, p. 406, fig. 214.
*Coscinodiscus curvatulus* var. *enermis* Grunow, 1884, p. 83.
*Coscinodiscus szontaghii* Pantocsek, 1886, p. 72, pl. 15, fig. 133.

Cells discoid, solitary. Valves almost flat, covered with coarse areolation. Areoles arranged in fascicules of curved lines. The first line of each fascicule runs from the centre of the valve to the margin, other shorter lines fill the sector, running parallel with the first line. Areoles polygonal, attaining their maximum size at a distance equal to half of the radius. Valve surrounded by a narrow margin, with short radial lines. Marginal apicules present at the end of the radial line of each fascicule, central area or rosette absent. Chromatophores: several rounded bodies. Diameter of valve 75–90μ.

An oceanic species having a wide distribution in temperate seas.

Observed at Sts. 334, 336, 337, 477, 661, 664, 666, 673, 675, 677.

**Coscinodiscus gracilis** Karsten.

Karsten, 1905, p. 78, pl. 3, fig. 4.

Cells discoid, very small, solitary. Valves strongly convex, with wide flattened edge or margin. Margin marked with radial lines. Surface of valve covered with granules, large and somewhat sparse in the centre, smaller and more dense in the peripheral zone. Chromatophores: few small irregular bodies. Diameter of valve 20μ.

A small neritic *Coscinodiscus* form, found only in the South Atlantic. It favours cold water and low salinity.

Observed at St. 666.

**Coscinodiscus grandenucleatus** Karsten.

Karsten, 1905, p. 86, pl. 7, fig. 9.

Cells discoid, solitary, valves convex. Valves covered with fine punctation arranged in fascicules of parallel lines; a second system of lines is radially arranged. Central area and marginal spines absent. Chromatophores: numerous irregular bodies, nucleus very large, absorbing dye readily. Diameter of valve 66–76μ.

A typical neritic species of Antarctic *Coscinodiscus*. Observed occasionally around South Georgia, but never in great numbers.

Observed at Sts. 338, 339, 340.

**Coscinodiscus hexagonalis** Karsten.

Karsten, 1905, p. 87, pl. 3, fig. 8.

Cells discoid, solitary. Valves nearly flat at the centre, sharply convex at the peripheral area. Valves covered with small but regular hexagonal areolation. Areoles small at the centre, slightly increasing in size up to a distance of half the radius, after which little or no increase in size is noticed. A small dot or poroid is clearly discernible at the base or floor of each areole. Central area and rosette absent. Marginal spinulae absent, girdle simple. Chromatophores: few plate-like bodies. Diameter of valve 160–190μ.

Observed at Sts. 460, 461.

**Coscinodiscus incurvus** Karsten.

Karsten, 1905, p. 85, pl. 7, fig. 8.

Cells discoid, solitary. Valves flat or nearly so. Valves covered with fascicules of puncta arranged in parallel lines. Central area of valve devoid of structure, puncta more or less the same size at all points over the valve surface. Girdle simple. Marginal spinulae absent. Chromatophores: few rounded bodies. Diameter of valve 70–90$\mu$, mostly 86$\mu$.

Observed at St. 666.

**Coscinodiscus inflatus** Karsten.

Karsten, 1905, p. 85, pl. 7, fig. 7.

Cells discoid, solitary. Valves flat or nearly so. Valves covered with fine puncta arranged in fascicules of parallel lines; no central hyaline area. Margin furnished with usually five elongated marks, radially disposed. Puncta at the central area somewhat indistinct, but, generally speaking, the same size over all the valve surface. Chromatophores: few rounded bodies. Diameter of valve 90–160$\mu$, mostly 120$\mu$.

This diatom, which is typically Antarctic, occurred in small numbers at one station only, off South Georgia. The specimens were consistently larger than those described by Karsten.

Observed at St. 475.

**Coscinodiscus kryophilus** Grunow.

Grunow, 1884, p. 81, pl. 3, fig. 21.
Karsten, 1905, p. 85, pl. 7, fig. 4.

Cells discoid, small, valves convex, strong. Valves covered with fine parallel lines of puncta; lines not closely packed, arranged in radiating fascicules. Punctation entire, no central hyaline area. Puncta uniform in size over the whole of the valve surface. Margin of valve furnished with a number of small but clearly marked spinulae. Chromatophores: numerous irregularly stellate or lobed bodies. Diameter of valve 40–44$\mu$.

A few specimens only were observed at one station on the 30th W. meridian, in the South Atlantic. The exact distribution of the species is unknown. It was recorded from the Arctic Seas by Grunow, but is never found in great numbers. The specimens observed were remarkably constant in size, and failed to attain the maximum diameter given by Karsten (100$\mu$). The species resembles *C. incurvus* Karsten, but is generally much smaller, and more robust. The striae of the latter are more densely arranged than in Grunow's species.

Observed at Sts. 301, 302, 666.

**Coscinodiscus pyrenoidophorus** Karsten.

Karsten, 1905, p. 84, pl. 5, fig. 11.

Cells discoid, solitary, small. Valves flat or nearly so. Valves covered with lines of puncta arranged in fascicules, with striae parallel to the middle radius of each fascicule. Central hyaline area present, small. Margin of valve devoid of structure, having the appearance of a plain hyaline peripheral area; spinulae absent. Chromatophores: a number of irregular plate-like bodies. Diameter of valve, 60–74$\mu$, mostly 70$\mu$.

A neritic species observed off the coast of South Georgia, never found in great numbers.

Observed at Sts. 335, 336, 337, 338, 666.

**Coscinodiscus simbirskianus** Grunow.

Grunow, 1884, p. 81.
Karsten, 1905, p. 86, pl. 6, fig. 5.

Cells discoid, solitary. Valves flat or nearly so. Valves covered with radiating lines of coarse granules arranged in fascicules. Striae parallel to the middle radius of each fascicule. Central area and rosette absent. Puncta uniform in size throughout the whole valve surface. Marginal spinulae and apiculi absent. Girdle narrow, striate, simple. Chromatophores: numerous oval bodies. Diameter of valve 80μ.

Observed at St. 664.

**Coscinodiscus subtilis** Ehrenberg.

Ehrenberg, 1843, p. 412, pl. 1, fig. 18.
Karsten, 1905, p. 86, pl. 7, fig. 11.
Lebour, 1930, p. 48, fig. 25*a*.

Cells discoid, solitary. Valves flat or nearly so, covered with very fine areolation. Areolation arranged in two systems, consisting of a series of rather more distinct oblique lines crossing radiating fascicules of parallel lines, and lines parallel to the middle radius of each fascicule. Areolation entire, central area and rosette absent. Marginal spinulae present, but rather difficult to see. Girdle simple, striate, narrow. Chromatophores: numerous plate-like bodies. Diameter of valve 80–130μ.

This species has a wide distribution in subpolar seas. It was observed frequently around South Georgia and appeared occasionally in the plankton taken around the Cape of Good Hope.

Observed at Sts. 260, 261, 475, 477, 478, 479, 480, 481, 482, 502, 506, 509, 510, 511, 512, 513, 664.

**Coscinodiscus trigonus** Karsten.

Karsten, 1905, p. 84, pl. 5, fig. 10.

Cells discoid, solitary, small to medium. Valves flat or nearly so. Valves covered with fine puncta arranged in radial fascicules, puncta in quincunx. Puncta uniform in size throughout the whole valve surface. The valve possesses three marginal marks, or ribs, arranged radially. Central hyaline area or rosette absent, spinulae absent. Chromatophores: a number of irregular bodies, consisting of four or five lobes. Diameter of valve 80–96μ.

A characteristic Antarctic form, having a wide distribution in the Southern Ocean, neritic.

Observed at Sts. 336, 337, 338, 505, 506, 507, 508, 509, 510, 666.

**Coscinodiscus variolatus** Castracane.

Castracane, 1886, p. 155, pl. 2, fig. 5.

Cells discoid, small. Valves flat or nearly so. Valve surface covered with puncta in fascicules of parallel lines. Numerous small clusters of prominent granules are irregularly disposed over the valve, superimposed as it were, upon the striations. These clusters are very small and give the surface of the valve a denticulate appearance when viewed under low magnification. Connective zone narrow, simple. Chromatophores: numerous small rounded bodies. Type locality, Philippine Islands. Diameter of cell 56–64μ.

This small form has a wide distribution throughout the Indian and Pacific Oceans. It was observed frequently in the Southern Ocean, particularly around Bouvet Island and South Georgia. The specimens exhibited great regularity of size.

Observed at Sts. 451, 463, 477, 478, 479, 501, 502, 503, 505, 506, 508, 510, 544.

### Genus Ethmodiscus Castracane

Castracane, 1886

**Ethmodiscus gazellae** (Janisch ex Grunow) Hustedt.

Hustedt, 1928, p. 375, fig. 196.
*Coscinodiscus gazellae* Janisch ex Grunow, 1879, p. 688.
*Ethmodiscus Wyvilleanus* Castracane, 1886, p. 170.
*Ethmodiscus tympanum* Castracane, 1886, p. 170.
*Ethmodiscus gigas* Castracane, 1886, p. 169.

Cells very large, cylindrical, circular in valve view, subrectangular in girdle view. Valves convex, often deeply so, central area flat, frequently depressed. Valves covered with extremely fine puncta in radial lines; central hyaline area present, area small. Girdle much developed, simple. Diameter of valve 700–1000μ; pervalvar axis up to 1500μ.

One of the largest known diatoms, somewhat weakly siliceous. It has a restricted distribution in the northern hemisphere, and has been reported from the Mediterranean by Pavillard. Widely distributed in the Southern Ocean, but seldom found in great numbers. An oceanic species favouring cold water.

Observed at Sts. 508, 510.

**Ethmodiscus subtilis** Karsten.

Karsten, 1905, p. 87, pl. 8, fig. 3.

Cells in valve view circular, cylindrical in girdle view. Valves weakly convex, sometimes slightly depressed at the centre. Valves covered with fine punctation. Puncta in the centre of the valve arranged in radiating lines, but in the peripheral area the lines appear to be somewhat curved. Central hyaline area and rosette absent. Spinulae absent. Girdle well developed, simple. Chromatophores: several small rounded bodies. Diameter of valve 40μ; pervalvar axis 54μ.

A small species having a wide distribution in the Antarctic. Neritic, but often found in deep sea plankton.

Observed at Sts. 570, 575, 615, 619, 661.

## Genus Schimperiella Karsten

Karsten, 1905

**Schimperiella antarctica Karsten.**

Karsten, 1905, p. 88, pl. 8, fig. 6.

Cells discoid, solitary, small. Valves convex, dissimilar. The upper valve is surrounded with a wide, flat margin, radially striate. The central portion is convex and covered with puncta arranged irregularly in sectors or whirls. Small central hyaline area present. Puncta smaller and more dense towards the margin. The lower valve possesses no striate flattened margin, but is uniformly convex throughout, and is furnished with puncta arranged in radial lines. The extreme margin of the lower valve is surrounded with a line of spinulae. Diameter of valve $48\mu$; pervalvar axis $12–15\mu$.

The genus *Schimperiella* is a small one, having its distribution in the Antarctic only. It is characterized by a peculiar form of dimorphism in the valves. It is probably closely allied to many of the Antarctic forms of *Actinocyclus*, wherein the same type of dimorphism is noticed frequently. Probably a neritic species only, but it is likely that it spends part of its time as a bottom form.

Observed at St. 475.

**Schimperiella valdiviae Karsten.**

Karsten, 1905, p. 88, pl. 8, fig. 7.

Cells discoid, solitary, small. Valves convex, dissimilar. The upper valve is surrounded with a strong and usually wide, flat margin, radially striate. The central portion is convex, and covered with striae, striae moniliform, radial. Small central hyaline area present. Puncta increase in size slightly and become more dense as they approach the margin. Lower valve also surrounded by a narrow margin, margin radially striate. The central area of the valve is convex and covered with small hexagonal areolation, areolation entire, no central hyaline area, and no central rosette. Areoles arranged in irregular tangential lines decreasing in size slightly as they proceed to the margin. Apiculi and spinulae absent. Diameter of valve $28–34\mu$.

A small neritic species having the same distribution as *S. antarctica*.

Observed at St. 461.

## Genus Charcotia M. Peragallo

Peragallo, M., 1921

**Charcotia bifrons** (Castracane) M. Peragallo. (Pl. X, figs. 6, 7.)

Peragallo, M., 1921, p. 78.
*Coscinodiscus bifrons* Castracane, 1886, p. 156.
*Charcotia Janus* var. *plana* M. Peragallo, 1921, p. 78.

Cells discoid, small. Valves flat or nearly so. Valves dissimilar. The valve surface of both the upper and the lower valve is very finely marked with exceedingly faint radial striation. Upon the upper valve the central area is furnished with a small irregular ring of puncta, from which radiate numerous lines of rather coarse puncta. These lines are either long or short, some consisting of a few dots only, but all fail to reach the margin of the valve, leaving what appears to be under a low power objective a hyaline marginal band. The lower valve has also a central ring of granules, from which radiate lines of puncta, lines usually less dense and less numerous, approaching more closely to the valve margin, but seldom if ever joining it. Margin strong, sometimes finely striate. In this species I include also *Charcotia Janus* var. *plana* M. Peragallo, as I found it was impossible to separate them. *C. Janus* M. Peragallo might be considered as a separate species, but I find that the small prominences placed in a circle near the margin are very variable in form and number, and I feel that this feature is too inconstant to be made a specific character.

A small species widely distributed throughout the Southern Ocean, seldom found in great numbers, most probably oceanic.

Observed at Sts. 461, 463, 479, 512, 551, 552, 560, 570, 575, 576, 578, 661; WS 481.

### Genus **Planktoniella** Schütt

Schütt, 1893

**Planktoniella sol** (Wallich) Schütt. (Pl. XIII, fig. 1.)

Schütt, 1893, p. 20, fig. 8.
Karsten, 1907, p. 369, pl. 39, figs. 1–11.
Lebour, 1930, p. 50, pl. 1, fig. 5.
Hustedt, 1929, p. 465, fig. 259.
*Coscinodiscus sol* Wallich, 1860, p. 38, pl. 2, figs. 1–2.
*Planktoniella Woltereckii* Karsten, 1905, p. 157.

Cells discoid, consisting of a central "coscinodiscoid" body surrounded by a wing-like expansion of peripheral loculi. Central or valvar portion small, valves convex, covered with large polygonal areolation arranged in tangential curved lines, somewhat similar to the structure of *Coscinodiscus excentricus*. The extracellular expansion is divided into a varying number of loculi by radial rays. These chambers may be turgid or flaccid. It is probable that by controlling the turgidity of the peripheral loculi, the organism has the power to alter its habit from that of a bottom form to a pelagic one. The photosynthetic elements are restricted to the valvar portion of the organism. Chromatophores: several plate-like bodies. Diameter of valve portion 30–180$\mu$, total diameter often as much as 360$\mu$.

The ratio between the diameter of the valvar portion and the total diameter of the organism (including the wing-like expansion) differs very considerably. It was noticed that the specimens in the neighbourhood approaching the Antarctic convergence (Sts. 450, 451, 452) possessed very small valvar portions and relatively large peripheral wings. Often the valve measured less than one-fifth of the total diameter. The loculi were numerous but narrow. Those specimens observed from tropical stations, particularly those to the north of Madagascar were very large in the valve portion and large also in the wing expansion, but the diameter of the valve was usually half the total diameter of the organism. The loculi were fewer in number, and were usually considerably inflated.

An oceanic species with a wide distribution occurs in European waters, but is found in great numbers in tropical and subtropical seas.

Observed at Sts. 260, 261, 262, 263, 264, 265, 289, 424, 425, 427, 428, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 449, 450, 451, 452, 673, 675, 684, 690, 1373, 1376, 1572, 1574, 1575, 1581, 1583, 1584; WS 621, 622, 623, 629, 630, 631, 640, 641, 642, 643, 644, 645, 666, 705, 706, 715, 716.

**Planktoniella formosa** (Schimper ex Karsten) Karsten.

Karsten, 1928, p. 146, pl. 218.
*Valdiviella formosa* Schimper ex Karsten.
Karsten, 1907, p. 369, pl. 39, fig. 12.

Cells discoid, solitary. Valves flat or nearly so, slightly convex towards the margin. Valves covered with faint cellulation, somewhat similar to that of *Coscinodiscus excentricus*. Valves surrounded by a wide and strongly developed extravalvar wing-like expansion, similar to that of *Planktoniella sol*, but differing from it in that, in *P. formosa*, the strengthening radial ribs which divide the wing into chambers are straight, rigid, frequently wide, and much more numerous than in *P. sol*, fifty to seventy ribs being present. The radial ribs do not directly join the margin of the valve portion, but appear to be attached to a strong circular frame, outside the margin of the valve proper. The bases of the individual chambers are neatly curved or rounded, and not angular as in *P. sol*. The chambers are open upon the outer margin, and bear radial striation. This radial striation makes the wing-like membrane rigid, so that it is observed neither in a state of collapse nor of extreme turgidity, as in the case of *P. sol*. Chromatophores: numerous small rounded or oval plates. Diameter of valve 40–54$\mu$; total diameter including extravalvar expansion 80–110$\mu$.

Observed at St. 440.

## Genus **Gossleriella** Schütt

Schütt, 1893

**Gossleriella tropica** Schütt. (Pl. XII, fig. 1.)

Schütt, 1893, p. 20, fig. 7.
Karsten, 1907, p. 368, pl. 40, figs. 14–17.
Hustedt, 1929, p. 500, fig. 280.

Cells discoid, usually solitary, but sometimes forming short chains. Valves convex, but sometimes slightly flattened. Valves without visible structure, but furnished with a marginal corona of stout bristles which proceed from small nodules or thickenings around the edge of the valve in the valvar plane. Between each stout bristle is a number, usually three to six, of finer bristles which are often a little shorter than the stout ones. The valve margin may be furnished with three distinct coronas of bristles. Upon some specimens a corona of bristles was observed proceeding from the centre of the valve numerous short spines are dotted frequently over the remainder of the valve.

Chromatophores: numerous cocciform bodies lying close to the margin of the valve. Diameter of valvar portion 200–220μ; length of bristles usually 70–76μ.

A weakly siliceous species, seldom found in large quantities, but having a wide distribution in tropical seas. Oceanic, favouring a low salinity. Common in the Indian Ocean. Observed most frequently in material from around Madagascar.

Observed at Sts. 440, 1373, 1575, 1583, 1586; WS 630, 631.

### Genus Actinocyclus Ehrenberg

Ehrenberg, 1838

Ehrenberg (1838, p. 171) established the genus *Actinocyclus*, with the following characters: "*Animal e familia Bacillariorum, liberum, lorica simplici, bivalvi (silicea), subcylindricum (disciforme), septis internis radiantibus pluribus, divisione spontanea imperfecta cateniforme.*"

Two species were described (p. 172) in the following manner:

210. *Actinocyclus senarius* sechszellige Strahlendose, Tafel 21, fig. 6. *A. lorica cellulosa, disciformi, radiis internis cellulisque senis.*

211. *Actinocyclus octonarius*, achtzellige Strahlendose, Tafel 21, fig. 7. *A. lorica cellulosa, disciformi, radiis internis cellulisque octonis.*

Ehrenberg did not state which of the above he regarded as the type of the genus, and the generic description does not accurately describe either of them, but may apply equally well to both. It is quite likely that Ehrenberg did not appreciate fully the structure of the organisms he described, but it is evident that subsequently he recognized certain differences between the two species. The illustration provided in his fig. 6 shows a small circular valve, regularly and clearly divided into six compartments by definite radiating lines. The segments are alternately light and dark, and filled with granules. Fig. 7 on the same plate shows a larger discoid valve, divided into eight compartments. The segments are not alternately light and dark, and are filled with fine dots.

Bailey (1842, pp. 93, 94, 96) made use of the genus *Actinocyclus* Ehrenberg, to which he referred a number of specimens found fossil from Richmond, Virginia, and produced figures of *Actinocyclus* (pl. 2, figs. 9–11) which are identical with that of Ehrenberg (1838, pl. 21, fig. 6). Bailey, however, did not make any specific determinations. Referring to his own work (1842, p. 94) he made the following note:

> Note, October 10th, 1841. Since the above was ready for the press, I have seen in the appendix to Pritchard's *History of Infusoria*, living and fossil, some interesting statements of recent discoveries by Ehrenberg, with reference to the genera of *Actinocyclus* and *Coscinodiscus*... (p. 96). Of the genus *Actinocyclus*, Ehrenberg describes several new species.... Several of these species have no partitions, but have surfaces marked with minutely punctate rays....

Bailey here referred to an appendix to Pritchard (1841), wherein are described seven species of *Actinocyclus*. At this point it is clear that Ehrenberg had included in the genus *Actinocyclus*, two distinctly different forms. Ehrenberg himself was aware of this, and feeling that a separation ought to be made, introduced the subgeneric heading *Actinoptychus*, yet undescribed, in the following manner "*Actinocyclus* (*Actinoptychus*) *senarius*" "synonym *Actinocyclus senarius* 1838". (Ehrenberg 1840*a*, p. 137, pl. 4, fig. 1 *a–e*.)

In subsequent work, Ehrenberg (1854, pl. 19, fig. 11, pl. 21, fig. 8) consistently referred *Actinocyclus senarius* 1838 to the genus *Actinoptychus* 1843, p. 400, but retained *Actinocyclus octonarius* (1838, p. 172, pl. 21, fig. 7) as the type species of the genus *Actinocyclus*.

Examination of figs. 6 and 7 on pl. 21 (1838) might lead one to suppose that the organisms illustrated are congeneric, and the descriptions provided do not reveal any difference between the two species except in the number of internal rays. But in view of the definite way in which Ehrenberg separated *Actinocyclus senarius* to form the type species of the new genus *Actinoptychus* (1843, p. 400) and the improved illustrations of *Actinocyclus octonarius* provided in the *Mikrogeologie* (1854, pl. 21, fig. 11, and particularly pl. 22, fig. 14), it is clear that this is not so. The apparent similarity between figs. 6 and 7 on pl. 21 (1838) must be explained as the result of a lack of intimate knowledge of the characters which Ehrenberg himself subsequently emphasized as the chief differences between the two genera. The confusion arose in the first place because Ehrenberg placed the same interpretation upon the furrows on the valve of *Actinoptychus* as upon the interfascicular spaces on the valves of *Actinocyclus*.

### **Actinocyclus bifrons** Karsten.

Karsten, 1905, p. 92, pl. 9, fig. 8.

Cells discoid, solitary, valves dissimilar. Upper valve slightly convex, usually flattened at the centre, surrounded by a very narrow radially striate margin. Valve surface covered with puncta. Puncta irregularly arranged towards the central area of the valve, often obscurely concentric. In the peripheral area the puncta are arranged in fascicules of parallel lines, lines parallel to the first or radial line of each fascicule. Pseudo-ocellus small, inconspicuous, marginal. The lower valve is more deeply convex, and is surrounded by a broad radially striate margin, the striate portion bounded by a narrow hyaline margin. The valvar portion is covered with moniliform striae, striae in fascicules of parallel lines in the peripheral area, but somewhat sparse and irregularly arranged in the central area. A small pseudo-ocellus present upon the striate margin, not connected with the valvar portion; pseudo-ocellus globiform. Chromatophores: numerous small cocciform bodies, often conglomerated. Diameter of valves 70–90$\mu$.

A typical Antarctic species, neritic, probably spending some of its time as a bottom form. Common around the South Sandwich Islands and South Georgia.

Observed at Sts. 368, 369, 378, 379, 380, 381, 382, 384, 475, 477, 478, 508, 510, 576.

### **Actinocyclus complanatus** Castracane.

Castracane, 1886, p. 145, pl. 4, fig. 9.

Cells discoid, valves almost flat, slightly convex at the margin. Valves covered with a fine areolation arranged in radiating fascicules of parallel lines. Areoles entire over the whole surface; central hyaline area absent. Margin complex, consisting of a wide band of larger puncta arranged in concentric lines; puncta decussate, beyond which is an outer or marginal band which is radially striate. A ring of stout spines decorates the inner marginal band of puncta. A prominent pseudo-ocellus is situated just inside the inner marginal band, pseudo-ocellus circular. Diameter of valve 100–140μ.

The type of the species was collected in the Sea of Japan. This species has been recorded from numerous localities in the northern hemisphere, particularly from the coasts of China and Japan, but has not been previously recorded from the Antarctic.

Observed at St. 505.

**Actinocyclus corona** Karsten.

Karsten, 1905, p. 92, pl. 9, fig. 6.

Cells discoid, solitary, small, valves similar. Valves convex, slightly flattened towards the centre. Valve covered with granules in radial lines; puncta somewhat indistinct in the central area, more prominent in the peripheral area. A corona of very prominent and slightly larger puncta occurs at a distance equal to about half the radius. This corona usually occupies three or four concentric lines of puncta. The valve is surrounded with a narrow hyaline margin. Pseudo-ocellus small, marginal. Diameter of valve 40μ.

A small neritic species, seldom occurring in large numbers.

Observed at St. 453.

**Actinocyclus elegans** Karsten.

Karsten, 1905, p. 93, pl. 9, fig. 9.

Cells discoid, solitary, small. Valves convex, often deeply so, surrounded by a broad flattened margin. Central area of valve flattened, sometimes slightly depressed, and furnished with a distinct rosette of eight to ten cells. The remainder of the valve surface is covered with hexagonal areolation decreasing in size as it proceeds to the margin. Four darker lines radiating from the central rosette divide the valve into equal parts. These lines are sometimes distinct over their entire length, but may be obscure in places, or entirely absent. Margin flat, inner zone faintly punctate, outer zone hyaline. A small rounded pseudo-ocellus present, situated upon the outer hyaline zone. Diameter of valve 50–64μ.

A small neritic species, probably a bottom form.

Observed at St. 666.

**Actinocyclus intermittens** Karsten.

Karsten, 1905, p. 92, pl. 9, fig. 5.

Cells discoid. Valves convex, slightly flattened towards the centre. Valves covered with puncta, somewhat irregularly arranged towards the centre, but in radial lines in the peripheral area. Valve surrounded with a narrow hyaline margin, furnished with a small pseudo-ocellus. Diameter of valve 64μ.

Neritic, widely distributed in the Southern Ocean, but seldom found in numbers.

Observed at Sts. 384, 461, 477, 543, 544, 551, 570; WS 548, 549, 550.

### Actinocyclus Janus Karsten.

Karsten, 1905, p. 92, pl. 9, fig. 7.

Cells discoid, solitary. Valves dissimilar. Upper valve slightly convex, usually flattened at the centre. Valve surface covered with puncta. Puncta arranged in irregular concentric lines, sparse towards the centre of the valve, often leaving a small central hyaline space. Pseudo-ocellus small, marginal, oval. The lower valve is more deeply convex, particularly towards the margin, very much flattened at the centre, sometimes slightly depressed. Valve surrounded with a broad margin, radially striate, striae strong. Pseudo-ocellus oval to globiform, situated upon the striate margin. Valvar portion covered with puncta, sparse at the centre, and irregularly arranged. Puncta more dense towards the margin and in irregular concentric lines. Chromatophores: numerous small bodies. Diameter of valve 52–58$\mu$.

Observed at Sts. 378, 379, 380, 382, 383, 475, 477, 478, 479, 480, 501, 503, 505, 506, 508.

### Actinocyclus octonarius Ehrenberg.

Ehrenberg, 1838, p. 172, pl. 21, fig. 7.
*Actinocyclus Ehrenbergii* Ralfs ex Pritchard, 1861, p. 834.

Cells discoid, solitary. Valves convex, deeply so at the margin, central area often flattened. Valve covered with moniliform striae. The striations consist of a varying number of radial lines which proceed from the margin of the valve to a small cluster of puncta at the centre, dividing the valve surface into radial compartments. Each compartment is furnished with a fascicule of lines of puncta, the lines being parallel to the median or radial line of each fascicule. As the fascicule does not completely fill the compartment that contains it, the main radial lines forming the compartments appear to be surrounded by hyaline interfascicular spaces, so that when the valve is viewed with a low power objective, it has the appearance of being divided by a number of transparent radial rays. Peripheral area more finely striate, and furnished upon the outer zone with marginal apiculi. A narrow outer margin is finely radially striate. When viewed with a low power objective (1–$\frac{1}{2}$ in.) the valve has the appearance of possessing concentric zones of beautiful colours, but these are diffraction effects which disappear when an objective of high numerical aperture is used. Marginal pseudo-ocellus present, small, rounded. Girdle plain, simple, no intercalary bands. Chromatophores: numerous small plates. Diameter of valve 170–220$\mu$.

A neritic species, having a cosmopolitan distribution; particularly numerous in temperate seas.

It has been explained under the title of the genus, how this species became the type. Two species were described by Ehrenberg when the genus was created, but one of them, namely *Actinocyclus senarius*, was removed to become the type of the genus *Actinoptychus* (Ehrenberg, 1843, p. 400). The number of compartments present upon the valve surface may vary very considerably. Ehrenberg found that it varied from three to 120. For each of these variants he proposed a specific name. Subsequent research showed that this variation could not be considered a specific character, as it was often found that the two valves of one frustule might possess different numbers of compartments. Ralfs (in Pritchard, 1861, p. 834) gathered all these names together under "*Actinocyclus Ehrenbergii* new species". This procedure is illegal. In accordance with the *Rules of Nomenclature* the name first applied to a member of a group shown to be synonymous, must be the name selected. *Actinocyclus octonarius* Ehrenberg was included by Ralfs in "*Actinocyclus Ehrenbergii* new species". As this is the type species, it is the oldest name of any member of the group of 118 variants. It is here reinstated in place of Ralfs's combination.

Observed at Sts. 260; WS 481.

**Actinocyclus rotula** Brun.

Brun, 1891, p. 6, pl. 17, fig. 5.

Cells discoid, small. Valves flat. Valve surface divided into a number of segments, usually 12–16, by radial lines of granules. These radial lines terminate in a small spur or apicule at the margin of the valve. Small central hyaline area present. The interstitial segments contain a number of puncta, irregularly arranged. Puncta sparse, but usually more dense at the marginal area of the valve. Margin of valve strong, radially striate. Chromatophores: numerous small plates. Diameter of valve 66$\mu$.

Observed at St. 260.

**Actinocyclus umbonatus** Castracane.

Castracane, 1886, p. 145, pl. 4, fig. 4.
Karsten, 1905, p. 91, pl. 9, fig. 1.
*Actinocyclus valdiviae* Karsten, 1905, p. 92, pl. 9, fig. 3.
*Actinocyclus antarcticus* Karsten, 1905, p. 91, pl. 9, fig. 2.

Cells discoid, valves convex, surrounded with a broad flat margin. Margin radially striate, the striae sometimes proceeding from a ring of fine puncta. Striate portion of the margin often bounded by a narrow plain, or hyaline rim. Valve surface covered with moniliform striae often arranged in radiate fascicules or in tangential sectors of curved lines. Puncta uniform in size throughout the whole valve surface, central hyaline area sometimes present, small. The marginal mark, or pseudo-ocellus is prominently placed upon the striate margin. Mark elongated, rectangular, spatulate, or clavate. Marginal spinulae absent. Chromatophores: numerous flattened bodies, irregular in shape, somewhat angular. Diameter of valve 54–138$\mu$.

A neritic species, which undergoes much variation. Widely distributed throughout the Southern Ocean, but seldom found in great numbers.

From the vast amount of material I had at my disposal, I found no difficulty in establishing the fact that Karsten's species were but variants of *A. umbonatus* Castracane.

Observed at Sts. 477, 478, 664.

## Family HEMIDISCACEAE

### Subfamily *HEMIDISCOIDEAE*

Cells solitary, valve oval-semicircular to sublunate, cuneate in girdle view, surface minutely punctate, radiate, eccentric, numerous marginal spinulae, small ocellus upon ventral margin ... ... ... ... ... ... ... ... ... ... *Hemidiscus*

### Genus Hemidiscus Wallich

Wallich, 1860

After examining a great number of specimens, Castracane (1886) came to the conclusion that no real difference existed between the genus *Euodia* Bailey and *Hemidiscus* Wallich, and desired to unite them under one generic name. He stated that: "Since, then, the genus *Euodia*, Bail. was instituted prior to that of *Hemidiscus*, Wall. the name of the united genera must be *Euodia*, Bail." Castracane is in error here, for the reverse is the case. The genus *Euodia* was established in 1861 and *Hemidiscus* in 1860.

**Hemidiscus cuneiformis Wallich.**

Wallich, 1860, p. 42, pl. 2, figs. 3–4.
Hustedt, 1930, p. 904, fig. 543 *e*.
*Euodia cuneiformis* Schütt, 1896, p. 100.
*Euodia radiata* Castracane, 1886, p. 150, pl. 12, fig. 4.
*Euodia inornata* Castracane, 1886, p. 149, pl. 12, fig. 1.

Cells cuneiform, solitary. Valves almost semicircular; dorsal margin strongly convex, ventral margin weakly so, often furnished with a median inflation upon the ventral side. Apices rounded, sometimes slightly produced. Valve covered with fine areolation arranged in irregularly radial fascicules; areoles in short parallel lines particularly towards the centre of the valve, irregular or in tangential sectors towards the margin and apices. Central hyaline area and rosette absent. Apices furnished with a small inconspicuous process. Upon the ventral margin of the valve is a row of small spinulae, and a small pseudo-ocellus occupying a position half-way between the apices. Girdle wide upon the dorsal side and narrow upon the ventral side of the frustule, giving the cell the appearance of a quarter of an orange. Girdle simple, no intercalary bands. Chromatophores: numerous small rounded bodies. Diameter of valve, apical axis 80–174$\mu$; transapical axis 44–90$\mu$.

Castracane (1886) referred species of this genus to *Euodia* Bailey (v.s.). *Hemidiscus cuneiformis* has a wide distribution throughout tropical and subtropical seas, and has been observed occasionally in north European waters. It is an oceanic species.

Much variation in outline has been observed, and many species and varieties have been created upon such variable characters as the ratio between the apical and transapical axes, the degree of gibbosity displayed upon the ventral side, the convexity of the dorsal side, and the development of the marginal spinulae and pseudo-ocellus. From the vast amount of material examined from such widespread areas as the waters around the Cape of Good Hope, the West Coast of Africa, the mid-Atlantic and the Humboldt Current in the Pacific, specimens were obtained forming a series of intermediate forms that made it impossible to recognize the value of the nomenclatural species and varieties. All of the specimens observed have been referred to *H. cuneiformis* Wallich.

Observed at Sts. 260, 294, 427, 434, 440, 451, 452, 675, 677, 679, 684; WS 705.

## Family ACTINODISCACEAE

### Subfamily *STICTODISCOIDEAE*

1. Cells without internal membrane. Cells flat, valves circular or polygonal, surface coarsely punctate, radiate, furrows radiate ... ... ... ... ... ... *Stictodiscus*
2. Cells with internal membrane. Cells flat, valves circular, coarse areolation in concentric lines, furrows radiate ... ... ... ... ... ... ... ... *Arachnoidiscus*

### Subfamily *ACTINOPTYCHOIDEAE*

1. Cells solitary, valve surface divided into segments alternately raised and depressed *Actinoptychus*

### Subfamily *ASTEROLAMPROIDEAE*

1. Cells circular, valve surface divided into sectors by radial extensions of hyaline central area; all sectors equal in size ... ... ... ... ... ... ... ... *Asterolampra*
2. Cells circular, sometimes elliptical, surface divided into sectors by radial extensions of hyaline central area; sectors of unequal size ... ... ... ... ... *Asteromphalus*

### Subfamily *STICTODISCOIDEAE*

### Genus Stictodiscus Greville

Greville, 1861

**Stictodiscus affinis Castracane.**

Castracane, 1886, p. 119, pl. 1, fig. 4.

Cells discoid, solitary, strong. Valves flat or nearly so, sometimes slightly depressed at the centre. Valve covered with numerous strong radiating furrows. Furrows sometimes confluent, reaching to about half the radius, where they anastomose to form a reticulate appearance over the central area of the valve. Lines of strong puncta are arranged radially between the furrows. Puncta proceed from the margin of the valve, but seldom penetrate far into the reticulate central area. Sometimes the central area is furnished with one to three granules. Margin of valve strong, sharply curved downwards. Girdle simple, finely striate. Diameter of cell 80–200$\mu$.

This species has a wide distribution and has been observed frequently in Indian Ocean material. It is probably a bottom form, usually epiphytic upon larger algae. It was observed frequently in the material from the Bransfield Strait. This is the first record of this species from the Antarctic.

Observed at Sts. 664; WS 481.

## Genus Arachnoidiscus Bailey ex Ehrenberg

Nomen conservandum

Inter. Rules Bot. Nom. (1935), p. 119.

Ehrenberg, 1849.
*Hemiptychus* Ehrenberg, 1848.
*Arachnoidiscus* Bailey ex Ehrenberg, 1849.

There appears to have been a confusion in the literature concerning the authority for the generic name. Brown (1933) proceeded at great length to elucidate the history of the name, and yet, after clearly stating that it received its first publication by Ehrenberg (1849), credited the authorship to Deane, even after pointing out that "the name *Arachnoidiscus* is carefully omitted from the account, thus robbing Deane of the recognition due to him" (Brown, 1933, p. 13). Ralfs (in Pritchard, 1861) credited the name to Deane also.

The type species was first described under *Hemiptychus ornatus* Ehrenberg (1848). In the following year Ehrenberg changed the generic name to *Arachnoidiscus* upon a suggestion put forward by Bailey, in correspondence, on the grounds that *Hemiptycha* had been used as a generic name for insects.

The use of a name for a genus of animals does not preclude it from use as a generic name for plants, and upon that ruling it was quite unnecessary for Ehrenberg to establish *Arachnoidiscus*. Mann (1907, pp. 266–7) stated that: "Ehrenberg's excuse for abandoning his earlier name, *Hemiptychus*, is not valid.... As this first name of Ehrenberg's is valid and his diagnosis is clear and his type species well defined, namely *H. ornatus*, it must replace the better known and far more descriptive name invented by Deane." Mann continued to describe three species under *Hemiptychus*. Some years later Mann (1925) entirely retreated from that position, and in his *Marine Diatoms of the Philippine Islands* stated that his work "involves the rejection of a few names, chiefly generic ones, which appear earlier in print, but with verbal description or illustration, or in some cases both, so meagre and unsatisfactory as to make it a safer plan to treat them as *nomina nuda*, than to accept the alternative, to so amend and amplify them that they will be distinctly marked off from other genera subsequently discovered. They comprise chiefly the following, *Hemiptychus*, for the universally used *Arachnoidiscus*...." Farther on he says: "I am glad to here note that this upsetting of classical and long-established names on my part has not had the slightest influence on subsequent diatom literature" (Mann, 1925, p. 9).

I feel that this complete recantation is somewhat remarkable, and was due probably to causes other than those mentioned by Mann. It must be noted that the excuses put forward in the above quotation were not strictly true, particularly in the genus under consideration, from two points of view. Firstly, according to Mann's own statement in 1907, the diagnosis of the genus *Hemiptychus* was quite clear, and the type species well defined, and there was no case whatever for considering it as a *nomen nudum*, or for attempting to amend or amplify either the generic or specific descriptions. Secondly, no systematic literature of any account had appeared between the years 1907 and 1925 that contained a description of the genus or any of its species, so it can scarcely be said that

Mann's enforcement of the law of priority in nomenclature had brought any exceptionally disastrous results, or in fact influenced the literature in any way whatever. There is no question that the genus *Hemiptychus* was legally and validly described and that the use of *Hemiptycha* for a genus of insects does not in any respect invalidate it. It must be admitted that Ehrenberg willingly adopted Bailey's suggestion to change the name to *Arachnoidiscus*, either to avoid the chance of complications arising out of the similarity of the two names, or in deference to some unwritten understanding that existed amongst scientific men of that day.

The problem is a difficult one, and I feel that if Mann had reaffirmed his establishment of *Hemiptychus* in 1925, his decision would have completely dominated diatom literature of the twentieth century. It is a matter for regret that Mann's withdrawal of *Hemiptychus* made the conservation of a later name inescapable.

**Arachnoidiscus Ehrenbergii** Bailey ex Ehrenberg.

Ehrenberg, 1849, p. 64.
Hustedt, 1929, p. 471, fig. 262.

Cells discoid, solitary, usually epiphytic. Valves flat or nearly so, slightly raised in the centre. Valve surface almost completely divided into sectors by strong radial furrows. These primary rays penetrate almost to the centre of the valve and are joined upon the inner side by a broad central membrane. Primary rays usually eight to thirty-six. Shorter secondary rays of varying length are arranged radially between the primary ones. A system of short tertiary rays is sometimes observed, particularly in mature frustules. A small central hyaline area present. Covering the valve face, between the rays, is a coarse areolation. Areoles often arranged in pairs, in more or less regular concentric circles. The ring of markings that surrounds the small central area is usually larger than the others, and the markings themselves are often elongated, rectangular or cuneiform. Areoles over the remainder of the valve are subrectangular in shape. Chromatophores: several large plates. Diameter of valve 140–220$\mu$.

This species favours tropical and subtropical waters, so it is a matter of great interest to note its occurrence in the Bransfield Strait. Van Heurck (1909) reported *A. Ehrenbergii* var. *indica* from the Bellingshausen Sea, south-west of Peter Ist Island. A littoral diatom; it probably spends part of its time as a bottom form, epiphytic often upon red algae and corallines; sometimes found in large numbers.

Observed at St. WS 481.

## Subfamily *ASTEROLAMPROIDEAE*

### Genus **Asterolampra** Ehrenberg

Ehrenberg, 1844

**Asterolampra Grevillii** (Wallich) Greville.

Greville, 1860, p. 113, pl. 4, fig. 21.
Hustedt, 1929, p. 489, fig. 274.
*Asteromphalus Grevillii* Wallich, 1860, p. 47, pl. 2, fig. 15.
*Asterolampra rotula* Greville, 1860, p. 111, pl. 3, fig. 5.

Cells discoid, solitary. Valves almost flat. Central area occupying about one-third of the total diameter of the valve surface. Central area furnished with usually five or six short lines which furcate to produce a number of curved veins. These veins proceed one to each punctate sector, and vary in number from twelve to sixteen. Narrow hyaline rays proceed radially from the central area towards the periphery where they terminate in a short rounded process, dividing the peripheral area into sectors. Sectors punctate, puncta fine, usually arranged in fascicules of parallel lines. Puncta of uniform size throughout the whole valve-surface. Chromatophores, numerous rounded bodies. Diameter of valve 80–120$\mu$.

This species is widely spread throughout European waters, but was observed at one station only on the 30th W meridian. Probably oceanic; never found in great numbers.

Observed at St. 684.

**Asterolampra marylandica Ehrenberg.**

Ehrenberg, 1844, p. 76.
Hustedt, 1929, p. 485, fig. 271.
*Asterolampra septenaria* Johnson, 1852, p. 33.
*Asterolampra impar* Shadbolt, 1854, p. 17, pl. 1, fig. 14.

Cells discoid, solitary small. Valves almost flat, slightly undulated. Central area large, usually occupying one-half to three-fifths of the total diameter of the valve surface. Central area furnished with radiating lines. Lines straight, usually six to eight in number. Each line proceeds to the apex of a peripheral punctate sector. Short hyaline rays proceed from the central area to the periphery dividing the peripheral area into sectors. Sectors rounded, obtuse, finely punctate towards the margin of the valve. Puncta increase in size slightly towards the apex of each sector. Puncta arranged in irregular tangential lines. The marginal line of puncta towards the valve centre of each sector is usually larger than the others, and appears to be more prominent. The puncta in this marginal line are subrectangular. Chromatophores: few large irregular bodies. Diameter of valve 64–70$\mu$.

This diatom has a wide distribution throughout subtropical seas, and is very common in fossil material obtained from the eastern seaboard of the United States of America. The specimens observed in the Atlantic Ocean from a line of Stations along the 30th W meridian, were remarkably regular in size and possessed usually seven rays. Some specimens with six rays were observed, but only four with eight rays. An oceanic species favouring a high salinity.

Observed at Sts. 424, 425, 675, 677, 681, 684, 687, 690, 1575.

**Asterolampra Vanheurcki Brun.**

Brun. 1891, p. 10, pl. 14, fig. 1.

Cells discoid, flat. Valves divided into seven equal sectors by narrow rays radiating from a small central area. Central area traversed by seven simple radiating lines. Sectors covered with very fine punctation. The marginal line of puncta of each sector is stronger than the others, giving the sectors clear definition. The narrow ray terminates in a small indistinct spine. Chromatophores: numerous rounded bodies. Diameter of valve 186–220μ.

Observed at St. 1584.

### Genus **Asteromphalus** Ehrenberg

Ehrenberg, 1844

**Asteromphalus elegans** Greville.

Greville, 1859 *b*, p. 161, pl. 7, fig. 6.
*Asteromphalus wyvillii* Castracane, 1886, p. 134, pl. 5, fig. 6.

Cells discoid, flat or nearly so. Valves almost circular in outline. Valve surface divided into twelve to twenty-six sectors, by narrow regular rays which proceed from the hyaline central area. Central area large, occupying one-third more or less, of the total diameter of the valve surface. Central area traversed by a system of lines arranged around the sides of the nucleal line. Nucleal line in the form of a loop. Each small line is genuflexed, sometimes bifurcate and joins the apex of one of the radial sectors. Radial sectors regular, somewhat pointed toward the valve centre, or sharply truncated, and covered with fine puncta. Puncta usually larger towards the central area. Chromatophores: several rounded bodies. Diameter of valve 100–180μ.

This species was observed at one station only in the Humboldt Current, where it occurred in small numbers. A neritic form, recorded from off the Galapagos Islands by Mann. Type locality: Californian guano.

Observed at St. WS 630.

**Asteromphalus heptactis** (Brébisson) Ralfs ex Pritchard.

Pritchard, 1861, p. 838, pl. 8, fig. 21.
Gran 1905, p. 45, fig. 49.
Hustedt, 1929, p. 494, fig. 277.
Lebour, 1930, p. 52, fig. 28 *a*.
*Spatangidium heptactis* Brébisson, 1857, p. 296, pl. 3, fig. 2.
*Asterolampra heptactis* Greville, 1860, p. 122.
*Asteromphalus reticulatus* Cleve, 1873, p. 5, pl. 1, fig. 2.
*Asteromphalus ornithopus* Karsten, 1905, p. 90, pl. 8, fig. 13.

Cells discoid, small. Valves slightly convex, undulate, sometimes slightly oval in shape. Hyaline area eccentric, small, usually occupying one-quarter to one-third of the total diameter of the valve surface. Hyaline rays proceed from the central area to the periphery dividing the valve into seven sectors. One ray is usually much narrower and longer than the others, and proceeds from the centre of the hyaline eccentric area. A number of branched lines traverse the hyaline area and are arranged around the longer and narrow ray. Peripheral sectors areolate, areoles coarse, arranged in tangential lines. Areoles usually of uniform size throughout. Sectors not rounded. The hyaline rays terminate at the margin of the valve in a small process. The areolate sectors between the hyaline rays are often depressed. Diameter of valve 64–110μ, mostly 72μ.

A very variable species, commonly found in European waters. Frequently met with around South Africa, and in the Peru Current, but seldom in great numbers.

Observed at Sts. 425, 451, 453, 661, 677, 681, 1356, 1359; WS 550, 705, 706, 707, 709.

**Asteromphalus Hookerii Ehrenberg.**

Ehrenberg, 1844 *b*, p. 200, fig. 3.
Gran, 1905, p. 45, fig. 50.
Lebour, 1930, p. 52, fig. 28 *b*.
*Asteromphalus Buchii* Ehrenberg, 1844 *b*, p. 200, fig. 4.
*Asteromphalus Cuvierii* Ehrenberg, 1844 *b*, p. 200, fig. 7.
*Asteromphalus Humboldtii* Ehrenberg, 1844 *b*, p. 200, fig. 6.

Cells discoid, solitary, small. Valves somewhat convex, undulate. Hyaline area in the centre of the valve, occupying about one-half the total diameter of the valve surface. Hyaline rays proceed from the central area to the periphery dividing the valve into sectors. Rays five to seven in number, usually narrow. The rays are of equal length, but one is much narrower than the others. A system of radiating branched or zigzag lines traverse the central area, joining the apices of the peripheral sectors. Peripheral sectors areolate, areoles fine, arranged in tangential lines. Sectors not rounded towards the centre of the valve. Areoles of uniform size throughout. The hyaline rays terminate at the margin of the valve in a small process. Diameter of valve 44–60$\mu$.

This species has a wide distribution in temperate and subpolar seas. Common around South Georgia, often occurring in large numbers. Oceanic.

Observed at Sts. 261, 339, 365, 368, 378, 381, 382, 384, 386, 461, 475, 477, 478, 479, 480, 570, 577, 578, 580, 619, 661, 666, 1362; WS 481, 545, 549, 550, 551, 552A, 631; MS 86.

**Asteromphalus parvulus Karsten.**

Karsten, 1905, p. 90, pl. 8, fig. 14.

Cells discoid, solitary, small. Valves slightly convex. Hyaline area in the centre of the valve, very large, occupying one-half to three-quarters of the total diameter of the valve surface. Hyaline rays proceed from the central area to the periphery. Rays usually six in number and mostly wide, but one is always very narrow. Peripheral sectors wide, punctate. Puncta rather coarse, considering the size of the organism, and arranged in tangential lines. The central hyaline area is traversed by a number of radiating branched or zigzag lines, which join the apices of the punctate sectors. Apices of the sectors not straight or rounded but bearing a median depression. Hyaline rays terminate at the margin of the valve in a very small and indistinct process. A narrow hyaline margin surrounds the valve. Chromatophores: several small rounded bodies. Diameter of valve 22–40$\mu$.

This species is very like *A. heptactis*, but is quite distinct from it. A very small species favouring cold water of low salinity. Observed frequently in the Bellingshausen Sea and Drake Straits, but never in great numbers. Oceanic.

Observed at Sts. 368, 378, 379, 380, 381, 382, 383, 384, 575, 576, 577.

**Asteromphalus Roperianus Ralfs ex Pritchard.**

Pritchard, 1861, p. 838.
Karsten, 1905, p. 90, pl. 8, fig. 8.
*Asterolampra Roperiana* Greville, 1860, p. 120, pl. 4, fig. 14.

Cells discoid, medium to large. Valves convex, undulate. Hyaline area in the centre of the valve, usually occupying one-third of the total diameter of the valve surface. Hyaline rays proceed from the central area to the periphery. Rays usually seven in number, mostly narrow, one narrower than the others. Peripheral sectors punctate, puncta small, arranged in tangential lines. The marginal row of puncta upon the inner margin of each sector is usually more distinct than the others. Apices of sectors flattened, having rounded corners. Central hyaline area traversed by a number of radiating branched lines, joining the apices of the sectors. Chromatophores: numerous irregular bodies. Diameter of valve 100–120μ.

A handsome species usually considered as oceanic, but found frequently around South Georgia.

Observed at Sts. 475, 478, 503, 505, 508, 509, 510, 666.

### Genus **Actinoptychus** Ehrenberg

Ehrenberg, 1843

The type species of this genus, *Actinoptychus senarius*, was originally described as an *Actinocyclus* by Ehrenberg (1838). When the latter genus was established two species were described, *A. senarius* and *A. octonarius*. Recognizing that structural differences existed between them, Ehrenberg separated *A. senarius* and made it the type of a new genus *Actinoptychus* 1841 (1843), pl. 1, fig. 27.

**Actinoptychus senarius** (Ehrenberg) Ehrenberg.

Ehrenberg, 1843, pl. 1, part 1, fig. 27.
*Actinocyclus senarius* Ehrenberg, 1838, p. 172, pl. 21, fig. 6.
*Actinocyclus undulatus* Kützing, 1844, p. 132.
"*Actinoptychus undulatus* (Bailey) Ralfs", in Hustedt, 1929, p. 475.
"*Actinoptychus undulatus* (Bailey)", in Lebour, 1930, p. 51.
*Actinocyclus* sp., in Bailey, 1842, p. 94, fig. 11 (unnamed).

Cells discoid. Valves divided into mostly six sectors, alternately raised and depressed. Small hexagonal central area present. Sectors covered with coarse polygonal areolation, areoles large and small, irregular. Marginal areoles large, often elongated radially. Secondary structure in the nature of fine puncta upon the inner surface of the areoles. Each sector furnished with a stout apicule placed near the margin of the valve. Valve surrounded by a narrow outer margin, finely striate, and bearing a ring of fine spinulae. Chromatophores: several large plates. Diameter of valve 40–130μ.

A very variable species, with a wide distribution in subtropical seas. It has been reported from the Mediterranean, and occasionally from the North Sea. It was observed frequently around South Africa and in the Brazil Current.

It has been often said that there existed in the minds of early diatomists a confusion between *Actinoptychus* and *Actinocyclus*. Although this has now been settled, the following notes are included in order to make clear the reasons which have led to changes being made in the names of some well-known species. Ehrenberg (1838, p. 171) established the genus *Actinocyclus*. Two species were described and figured, *A. senarius* and *A. octonarius*. Later, other forms were added, and Ehrenberg, realizing that the genus contained more than one group, desired to make a separation. Ehrenberg 1840*a*, introduced a subgenus in the following manner:

"*Actinocyclus* (*Actinoptychus*) *senarius*, synonym *Actinocyclus senarius* 1838." Later Ehrenberg ((1841) 1843, p. 400) established the genus *Actinoptychus*. On a previous page (p. 328), and in the description of the plates, the combination *Actinoptychus senarius* was used, and there is reason to believe from the similarity of the figures provided that *Actinoptychus senarius* Ehrenberg was based on *Actinocyclus senarius* (1838). Ehrenberg (1843, p. 400) explained that the separation was necessary on account of structural differences that existed in *Actinocyclus* (1838) and continued at some length to explain the differences upon which the separation was made. *Actinocyclus octonarius* Ehrenberg (1838) was retained as the type species of *Actinocyclus*. The species *Actinoptychus senarius* is often attributed to Bailey in the following manner "*Actinoptychus undulatus* Bailey", but there appear to be no grounds for this. Bailey (1842) mentioned the occurrence of a number of species of *Actinocyclus* in fossil material from Richmond, Virginia, and provided figures which undoubtedly represented the species under consideration here, but the figures were unnamed. Ehrenberg (1843, p. 328) accepted Bailey's figure as being equal to his *Actinoptychus senarius*. Kützing (1844) took Bailey's illustration as a type illustration and described *Actinocyclus undulatus*. Ralfs (1861) placed this species in the genus *Actinoptychus*, but accepted Kützing's epithet. Ehrenberg's epithet is used here to satisfy the claims of priority.

Observed at Sts. 260, 261, 262, 263, 482, 719, 721, 1359; WS 100, 101, 103, 104, 105, 106, 107.

**Actinoptychus splendens** (Shadbolt) Ralfs ex Pritchard.

Pritchard, 1861, p. 840.
Hustedt, 1929, p. 478, fig. 265.
*Actinosphaenia splendens* Shadbolt, 1854, p. 16.

Cells discoid. Valve divided into sectors alternately raised and depressed. The number of the sectors varies considerably, but is usually sixteen, eighteen or twenty. Central area present, area almost circular. Sectors covered with coarse areolation. Areoles polygonal, furnished with secondary structure upon the inner wall. Adjoining sectors have different structure. On the one is a stout apicule placed at the margin of the valve; from the apicule proceeds radially a narrower hyaline line to the central area. The other sector is shorter, and does not join the margin, but leaves a narrow hyaline space at the broad or marginal end; also it seldom encroaches upon the central area to the same degree as the other sector, giving to the central area a stellate appearance. The valve is surrounded by a strong striate outer margin. Chromatophores: numerous plate-like bodies. Diameter of valve 120–140$\mu$.

Probably an oceanic species, observed but rarely off the coast of South Africa.

Observed at St. 260.

## Suborder BIDDULPHIINEAE

## Family BIDDULPHIACEAE

### Subfamily *BIDDULPHIOIDEAE*

1. Cells gonioid, united in chains, angles furnished with cornutate processes, valve surface granular, spinous ... ... ... ... ... ... ... ... ... *Biddulphia*
2. Angles furnished with short processes, valve weakly siliceous, hyaline, short central spine, margins minutely spinulate ... ... ... ... ... ... ... *Bellerochea*
3. Cells almost cylindrical, slightly twisted about pervalvar axis, valve surface punctate, bearing two short processes alternating with two spines ... ... ... *Cerataulus*
4. Cells without torsion, valves hyaline, furnished with two short processes each armed with a sharp spine... ... ... ... ... ... ... ... ... ... *Cerataulina*

### Subfamily *TRICERATIOIDEAE*

1. Cells polygonal, valves hexagonally areolate, areolation entire, transverse, processes cornutate ... ... ... ... ... ... ... ... ... ... *Triceratium*
2. Areolation not always entire, radial, angles furnished with an area of micropores ... *Trigonium*
3. Cells triangular, valve minutely punctate, processes absent, several marginal spinulae *Pseudo-Triceratium*
4. Cells triangular, hyaline, united in chains by extension of the connective zone, valve with short central spine... ... ... ... ... ... ... ... ... *Lithodesmium*
5. Cells triangular or prismatic, with long central spine ... ... ... ... ... *Ditylum*

### Subfamily *HEMIAULOIDEAE*

1. Cells biangular, sometimes almost circular, hyaline, valves furnished with two long slender processes, each bearing a small terminal spine ... ... ... ... ... ... *Hemiaulus*

### Subfamily *EUCAMPIOIDEAE*

1. Cells bipolar, in flat chains, valve surface granular, one eccentric spine ... ... *Eucampia*
2. Cells in flat chains, hyaline, valve surfaces contiguous... ... ... ... *Streptotheca*
3. Valve surfaces not contiguous, intercellular spaces elliptical ... ... ... *Climacodium*

### Subfamily *BIDDULPHIOIDEAE*

### Genus **Biddulphia** Gray

Gray, 1821

The biddulphioid diatoms have been carefully considered by Van Heurck, Boyer and others. The complexity of structure in this group has obscured all lines of generic demarcation to such a degree that many of the so-called genera are, from a systematic point of view, quite valueless. Van Heurck was so convinced of this that he absorbed many genera into the one genus *Biddulphia* Gray. This step, however, resulted in the collection under one name of many totally dissimilar forms, the only character possessed by them in common being angularity of outline. When considering a group of organisms which exhibit such a diversity of form, it becomes necessary to interpret the population in terms other than those of the published generic descriptions, which by reason of ambiguity have become inapplicable. When dealing with a genus, which, owing to inadequate description, contains a host of alien forms, it is reasonable to suggest that as the genus must stand or fall by the type species, certain characters of, or facts pertaining to, the type species should be used to establish more clearly the generic limits. To define the limits of the genus *Biddulphia* as interpreted by Van Heurck, would be a matter of great difficulty, or to be able to say definitely what is or what is not a *Biddulphia* would be an impossibility.

The type of the genus, *Biddulphia pulchella* Gray, exhibits admirably the characters of the genus as I would interpret it. The cells are elongated about the pervalvar axis. The valves are oval to oval-lanceolate in outline, occasionally constricted. The angles of the valves are produced to short but stout processes, slightly capitate. The valve surface is covered with coarse puncta arranged in irregular concentric lines in the central area. The central area is often furnished with two short, blunt spines, but these may be much reduced or absent. The valve mantle is often deep, sparsely punctate. The girdle simple, punctate. The cells frequently unite to form chains, often joined so that the valves are face to face, but they may be joined by one angle only, giving a zigzag appearance to the chain.

Upon such characters I define *Biddulphia*. Much variation is found amongst the species. The number of angles present may be two, three, four or more, but mostly two or three. The processes in the angles vary in shape and size, they may be small and rounded, or flattened so as to appear as an area merely marked off from the rest of the valve surface by a sulcus; or they may be large, erect and inflated, usually terminated by an area of either fine or coarse pores. The valve surface is punctate. The puncta may be exceedingly fine, granulate or spiny, but never hexagonally areolate. Isolated spines, usually large, may or may not be present upon the central area of the valve, and they are often developed more strongly upon the outer valve of a terminal member of a chain. The valves are often traversed by sulci which separate the angles from the central area, and the margins of the valves are frequently strengthened by costae or canaliculi. In habit the genus is mainly colonial and truly planktonic, neritic or oceanic, confined chiefly to temperate and subtemperate waters. The oceanic species often show great diversity in form and structure, particularly with regard to the degree of silicification. Generally speaking, holoplanktonic species are less strongly siliceous than meroplanktonic ones.

### Biddulphia antediluviana (Ehrenberg) Van Heurck.

Van Heurck, 1885, p. 207, pl. 109, figs. 4, 5.
*Amphitetras antediluviana* Ehrenberg, 1840 *a*.
*Triceratium antediluvianum* (Ehrenberg) Grunow, 1870, p. 24.

Cells angular, solitary, strong. Valves possessing four angles. Valves gently concave along the margins, valve centre depressed. Valve surface covered with large coarse areolation. Areoles subrectangular, arranged in concentric lines in the central area, irregularly parallel, subradiate, or sometimes slightly curved in the angular portions of the valve surface. Angles of valves furnished with large rounded or oval ocelli. Valve mantle deep, constricted just above the girdle zone. Beyond the constriction the valve is usually hyaline. Areoles upon the valve mantle usually larger than on the central area of the valve and somewhat rectangular in shape. Girdle large, furnished with a few irregular lines of small puncta, puncta rounded. Valve mantle slightly recurved after the constriction, as it meets the girdle. Pervalvar axis often greater than the diameter of the valve. Chromatophores: numerous oval plates. Diameter of valve 70–120μ; pervalvar axis mostly 100μ.

A neritic species, often epiphytic upon larger algae. The frustules attach themselves to the substratum by means of short mucous stipes or flat pads, exuded at the angles of the valve. The species has a wide distribution in temperate seas, and is common around European coasts, particularly upon the Atlantic side. It was observed at one station only in the Peru Current.

Observed at St. WS 629.

**Biddulphia astrolabensis** Hendey, sp.nov. (Pl. IX, figs. 1, 2, 3.)

*Frustulis* e facie connectivali visis rectangularibus; *cingulis* latis, simplicibus; *valvis* triangularibus, superficie plana, marginibus rectis vel subarcuatis; *costis* brevibus, 2 vel 3 utroque latere; *angulis* subacutis, lenissime productis, stromatophoris, stromatibus parvis, subtiliter punctatis; *punctis* minutis, subpinnulatis, sparse irregulariterque dispositis, in medio paucioribus.

*Mensura valvarum* 145μ inter angulos.

*Hab.* in aquis marinis "Bransfield Strait", prope insulam "Astrolabe" dictam, in mari Antarctica.

*Typus* in Herb. Mus. Brit. No. 33964.

A meroplanktonic species observed only in small numbers in the material from the Bransfield Strait where the net had touched bottom. The frustules were of extreme fragility, and only after making repeated attempts could a satisfactory mount be made. All the specimens were either dead or in a dying condition when the sample was taken, so no information was obtained concerning the photosynthetic elements. The structure of the valve indicated relationship with the primitive forms of the genus *Triceratium*, particularly those found in fossil deposits in central Europe, and quite unrelated to the progressive forms of cornutate neritic species, commonly found in the plankton of the southern seas.

Observed at St. WS 481.

**Biddulphia aurita** var. **obtusa** (Kützing) Hustedt.

Hustedt, 1930, p. 848, fig. 502.
*Biddulphia obtusa* (Kützing) Ralfs ex Pritchard, 1861, p. 848.
*Odontella obtusa* Kützing, 1844, p. 137.
*Biddulphia parallela* Castracane, 1886, p. 103.

Cells in girdle view oblong, in valve view bipolar, oval-lanceolate to elliptic-lanceolate. Pervalvar axis usually greater than the apical axis. Apices of the valve produced to form short but thick processes. Central area of valve slightly convex. Valve mantle deep, somewhat constricted as it meets the girdle or connective zone. Valve covered with puncta arranged in radiating lines. Puncta often sparse at the central area. Central area furnished with usually two stout spines placed together, spines divergent. Spines sometimes absent. Girdle deep, furnished with lines of puncta, interrupted by usually two hyaline bands. The frustules are found united together in zigzag chains by means of small cushions of mucous exuded at the processes. Chromatophores: numerous rounded or oval bodies. Polar axis 84$\mu$; pervalvar axis 124$\mu$.

A littoral species, frequently found around European coasts. It was observed in small numbers around South Georgia and in the Bransfield Strait.

Observed at Sts. 670; WS 481.

**Biddulphia longicruris** Greville.

Greville, 1859 *b*, p. 163, pl. 8, fig. 10.

Cells gonioid, often united to form chains. Four to twenty cells in a chain. Cells in valve view bipolar. In girdle view the valves show a prominent central inflation which bears a stout spine. The angles of the valves are produced to long slender processes. The valve surface is minutely punctate, puncta irregularly arranged and somewhat sparse. Chromatophores: numerous rounded bodies.

This species occurred frequently in the Peru Current. It is a neritic form which has a wide distribution in temperate and tropical seas, but has not been recorded from English waters. Type locality: Californian guano.

Observed at Sts. WS 593, 594, 598, 622.

**Biddulphia mobiliensis** (Bailey) Grunow ex Van Heurck. (Pl. XII, fig. 9.)

Van Heurck, 1880–5, pl. 101, figs. 4–6.
Gran, 1905, p. 106, fig. 138.
Hustedt, 1930, p. 840, fig. 495.
Karsten, 1905, p. 121, pl. 17, fig. 1.
Lebour, 1930, p. 174, fig. 134.
*Zygoceros mobiliensis* Bailey, 1851, p. 40, pl. 2, fig. 34.

Cells solitary, but sometimes united to form short chains. Cells in girdle view, shortly rectangular, in valve view elliptical to elliptic-lanceolate. The poles of the valves are produced to form long narrow processes. Valve mantle gently curved inwards beneath the processes to meet the girdle. Central area of the valve raised, flattened, or weakly concave, and furnished with two long, straight spines. Spines divergent, the distance between the spines only a little more than the distance between a spine and the apical process. The entire cell is covered with extremely fine areolation, which is seen only with the greatest difficulty. It may be observed more easily if the cells are examined when mounted dry. Chromatophores: numerous rounded bodies. Polar axis 80$\mu$; pervalvar axis 100$\mu$.

The species is widely distributed in both hemispheres. A weakly siliceous diatom; pelagic, but often associated with a coastal flora, and sometimes found in great numbers.

Observed at Sts. 260, 261, 434, 1373.

**Biddulphia polymorpha** (Grunow) Wolle.

Wolle, 1890, pl. 97, figs. 5, 11.
Hustedt, 1930, p. 851, fig. 505.
*Cerataulus polymorphus* Grunow ex Van Heurck, 1881, pl. 104, fig. 3.

Cells somewhat rectangular in girdle view, broadly oval in valve view. Valve surface flat or weakly convex. The poles of the valves are furnished with short but wide, almost circular processes. Valve surface covered with puncta. Puncta irregularly arranged in the central area of the valve, but in curved lines proceeding to the processes, in the polar axis between them. The puncta are arranged in straight lines radiating from the centre in the lateral areas of the valve. The whole surface of the valve is covered with short spinulae arranged in irregularly radiating lines. A group of larger spinulae, usually six in number, form an irregular ring around the central area. Girdle finely striate, striae moniliform. Chromatophores: numerous rounded bodies. Polar axis 120–140$\mu$; transapical axis 80–120$\mu$; pervalvar axis, 120$\mu$.

Observed at St. WS 481.

**Biddulphia anthropomorpha** Van Heurck. (Pl. XIII, fig. 5.)

Van Heurck, 1909, p. 39, pl. 10, figs. 136–7.
*Biddulphia punctata* Greville, var. Van Heurck, 1909, p. 41.
*Biddulphia Ottomulleri* Van Heurck, 1909, p. 40.
*Biddulphia Ottomulleri*, var. *rotunda* Van Heurck, 1909, p. 41.
*Biddulphia punctata*, var. *subtriundulata* Van Heurck, 1909, p. 41.
*Biddulphia punctata*, var. *subaurita* Van Heurck, 1909.
*Biddulphia translucida* Van Heurck, 1909, p. 42.
*Biddulphia litigiosa* Van Heurck, 1909, p. 40.
*Biddulphia polymorpha* Mangin, 1915, p. 27.

Cells gonioid, usually united to form chains. Valves bipolar, broadly oval to elliptic-lanceolate. Angles furnished with stout processes, terminally inflated. In some specimens the processes are ill-defined, and have the appearance of flattened areas, separated only from the central area by a sulcus in the valve surface. The central area of the valve is slightly inflated and frequently bears two stout spines, which diverge slightly. Valve surface covered with punctation, puncta spinous. Spines strongly developed on some cells, weakly on others, while on very young cells the spines may be absent altogether. Beneath the process the valve is slightly constricted, but evenly so. Valve mantle deep. Girdle usually simple, but may exhibit a few annular lines, sometimes finely striate, but often hyaline. Chromatophores: numerous rounded bodies. Polar axis 30–80$\mu$; pervalvar axis 60–130$\mu$.

Mangin (1915) became convinced that all the species and varieties created by Van Heurck in 1909 were but growth forms of one genotype, and explained that the degree of silicification, length of process, form of punctation and the presence or absence of spines could not be regarded as characters of specific value. He found frequently that the cells in the middle of a chain would possess some of the characters of one species, while the terminal cells possessed characters of another, and was able to trace specific continuity through the whole group. Mangin collected all the forms referred to under

*Biddulphia polymorpha* Mangin (1915, p. 27). This name was technically incorrect upon two grounds, firstly, because the name was preoccupied (*Biddulphia polymorpha* (Grunow) Wolle, 1890) and secondly, that as the group of forms described by Van Heurck merely represented variants of one species, the first name to be applied must be the name adopted. As all the names used by Van Heurck received publication simultaneously, *Biddulphia anthropomorpha* is used here by virtue of priority of place.

Observed at St. WS 481.

**Biddulphia regia** (Schultze) Ostenfeld. (Pl. XII, figs. 2, 3.)

Ostenfeld, 1908, p. 7, fig. 3.
Lebour, 1930, p. 175, fig. 135.
Hustedt, 1930, p. 838, fig. 494.
*Denticella regia* Schultze, 1859, p. 21, figs. 11, 12.

Cells somewhat rectangular in girdle view, broadly elliptic-lanceolate in valve view. The poles of the valves are produced to form narrow processes, which are frequently distinctly capitate. Valve mantle only very slightly curved inwards beneath the processes to meet the girdle, sometimes almost straight. Central area of the valve only slightly raised, often weakly concave, and furnished with two long spines. Spines slightly divergent at first, but bent towards the centre at a distance a little over half of their length. Spines with mucronate ends. Distance between the two spines usually much greater than that between the spines and the processes. Entire surface of the cell covered with fine areolation. Chromatophores: numerous rounded bodies. Polar axis 110$\mu$; pervalvar axis 40–120$\mu$.

A neritic species, commonly found in the northern hemisphere. It was observed at one station only off the east coast of Africa, below Madagascar.

Observed at St. 1373.

**Biddulphia striata** Karsten. (Pl. X, figs. 4, 5.)

Karsten, 1905, p. 122, pl. 17, figs. 2, 3.
Mangin, 1915, p. 22, fig. 1.

Cells rectangular in girdle view, broadly elliptical in valve view. The poles of the valves are weakly produced into short rounded processes. Central area of the valve slightly convex, furnished with four long, slightly curved spines. Median area of the connective zone, often somewhat inflated. The entire surface of the cell is covered with fine punctation, arranged in quincunx. Chromatophores: numerous stellate bodies. Polar axis 60–84$\mu$: pervalvar axis 120$\mu$.

One of the most common neritic diatoms around South Georgia, often found in great numbers. It has a very local distribution, and although occasionally found in the Bransfield Strait, particularly in the summer, it is seldom observed in the Weddell or Bellingshausen Seas. It is unlikely that it ever crosses the Antarctic convergence.

A weakly siliceous form which undergoes considerable variation in shape. It is found living free and also united, the horns or spines of adjacent frustules interlocking, to form short chains of three or four cells.

Observed at Sts. 368, 461, 475, 477, 478, 479, 480, 481, 482, 501, 502, 503, 505, 506, 508, 509, 510, 511, 512, 513, 544, 575, 577, 578, 580; WS 469, 474, 481; MS 86, 99.

### Genus **Cerataulina** H. Peragallo ex Schütt

Schütt, 1896

[*Cerataulina* H. Peragallo, 1892]

The name *Cerataulina* was first used by H. Peragallo in his Monograph of the genus *Rhizosolenia* (1892). The following quotation is taken from his work.

> C'est à ce genre que j'ai rapporté sous le nom de *Cerataulus Bergonii* une petite forme pélagique très abondante dans la récolte pélagique 59–60 des séries Tempère et Peragallo.... Les deux appendices sont munis de petites épines. Les caractères de cette espèce seraient peut-être assez distinct de ceux des vrais *Cerataulus* pour en faire un genre particulier, *Cerataulina*, caractérisé par la longueur toujours relativement grande et l'annulation constante de la zone.

Peragallo seems to have been in considerable doubt whether the characters enumerated would be sufficiently constant or definite to provide for the establishment of a new genus. This is brought out more clearly by the fact that he did not make, in any place, the combination *Cerataulina Bergonii*. The figure he provided (pl. 1, fig. 16) was named *Cerataulus* (*Cerataulina*) *Bergonii*. In view of the doubt expressed by Peragallo in the above quotation and the fact that the name *Cerataulina* was not used by him in the correct generic sense in describing a type species, the authorship of the genus cannot be credited to Peragallo.

The genus *Cerataulina* was described by Schütt (1896, p. 95). *Cerataulina Bergonii* was figured upon p. 96, fig. 165, based upon *Cerataulus Bergonii* Peragallo, 1892, p. 103, pl. 13, figs. 15, 16. Schütt apparently was unaware that the organism had been previously described by Cleve (1889) under *Zygoceras? pelagicum*. I consequently give *Cerataulina pelagica* (Cleve) Hendey as the type of the genus *Cerataulina* Schütt, as Cleve's epithet was the earlier.

**Cerataulina pelagica** (Cleve) Hendey, comb.nov.

*Zygoceras? pelagicum* Cleve, 1889, p. 54.
*Cerataulina Bergonii* (H. Peragallo) Schütt, 1896, p. 95.
*Cerataulus* (*Cerataulina*) *Bergonii* H. Peragallo, 1892, p. 103, figs. 15, 16.

Cells cylindrical, pervalvar axis usually twice or three times the diameter. Cells united to form chains, often twisted. Valves slightly convex, furnished with two short, stout cylindrical processes. Processes opposite, terminated with a short spine. Valve mantle short. Girdle composed of intercalary bands, seen only with great difficulty. Chromatophores: numerous cocciform bodies. Nucleus often pressed against the cell wall. Cells very weakly siliceous. Diameter of valve 36–56$\mu$; pervalvar axis 70–130$\mu$.

This species is common in the neritic plankton of warm seas. It is found also in North European seas and Scottish lochs.

Peragallo (1892, p. 103) first used the name *Cerataulina*, but the figure provided was described as *Cerataulus* (*Cerataulina*) *Bergonii*. Cleve (1894, p. 11) referring to this species under the name of *Cerataulina Bergonii* said: "It was first described by me as *Zygoceras? pelagicum* (*Kanonbaaden* "*Haucks*" *Togter*, p. 54) but from dried and misshapen specimens. Consequently my description and figure leave much to desire and I prefer the name given by Peragallo who accurately figured it." As Cleve was perfectly satisfied that his *Zygoceras? pelagicum* was identical with Peragallo's specimen, Cleve's epithet must be accepted as being the earlier one. If Cleve had included a description of the genus *Cerataulina* in 1894, the authority would have to be credited to him.

Observed at Sts. 434, 481.

### Genus **Bellerochea** Van Heurck

Van Heurck, 1885

**Bellerochea indica** Karsten.

Karsten, 1907, p. 393, pl. 46, fig. 2.

Cells shaped like dumbbells in girdle view, linear-lanceolate in valve view. United to form flat ribbon-like chains. The poles of the valves are raised and slightly produced to form large flattened processes which adhere closely to the corresponding processes of the adjacent cell at both poles. Surface of valve somewhat undulating, slightly inflated in the middle. When seen in girdle view in chain formation, the intracellular spaces are large, and elliptic-lanceolate. Chromatophores: numerous short vermiform bodies. Cell nucleus very prominent, occupying a central position. Polar axis 160$\mu$; pervalvar axis 16–20$\mu$; intracellular space 24$\mu$ at pervalvar axis.

A large weakly siliceous pelagic form, common in the Indian Ocean. Observed at two stations to the south-east of Cape of Good Hope, in ribbon-like chains of ten to thirty cells in each chain. Although often associated with a coastal flora, it is probably holoplanktonic.

Observed at Sts. 425, 428.

### Genus **Trigonium** Cleve

Cleve, 1868

The genus *Trigonium* Cleve was established upon *Triceratium arcticum* Brightwell. Cleve was dissatisfied with the composition of the genus *Triceratium* Ehrenberg, and perceived in Brightwell's species certain fundamental differences which he intended to use as the basis of a new genus. The generic description of *Trigonium* was as follows: "*Huvudytan triangular, sidoytan rektangelformig utan framspringande utskott eller hörn.*"

Unfortunately this description did not prove sufficiently precise to exclude a large number of forms which I do not think Cleve had any idea of admitting when the genus was created. Mann in 1907 adopted *Trigonium*, which until then had been monotypic, and added to it a large number of species which had been previously described under the generic heading of *Triceratium*. These species did not bear the slightest resemblance to the type species and entirely ruined the value of Cleve's work, which consequently fell into disuse. The majority of them were triangular forms of *Biddulphia* possessing granular valves, whose processes were either very much reduced or by reason of the general valve structure rather difficult to define. Cleve's genus is adopted here in the sense in which its author originally conceived it. I do not intend to alter or in any way add to the generic description, but I hope to re-establish the genus by a clearer interpretation of the salient characters of the type species.

The genus based upon *Triceratium arcticum* Brightwell is a small and clearly defined one, consisting of about thirty species and varieties. It is composed of what was generally known as the *arcticum* group of *Triceratium* Ehrenberg. The cells are polygonal in valve view, rectangular in girdle view. The valve surface is slightly convex on concave, and covered with a polygonal areolation which is usually arranged in radiating lines. It is probable that the structure of the areoles differs amongst the species. In the main the areoles appear as loculi or chambers, closed upon the outer surface, but have connection with the interior of the frustule by means of poroids upon the lower wall or floor. The angles of the valves are rounded and seldom much produced, no raised process or horn of any description appears in the angles. The angles are often a little lower than the central area of the valve, and are furnished with a differentiated area of very fine pores. This area is shaped like a thumb-mark, and exudes the mucilaginous stipe or cushion, by which the frustule attaches itself to the substratum. The valve mantle is deep but never constricted, it is finely areolate. The girdle is always simple, and finely areolate. The girdle is usually as wide as the valve mantle is deep, giving the cell in girdle view the appearance of three equal rectangular zones. The cellulation upon the valve surface is usually entire, but may break down at the centre to form a few isolated puncta. The valve surface is entirely devoid of spines, sulci, canaliculi or costae.

The genus is littoral. The cells almost invariably begin their existence attached to a substratum, and are solitary in habit. Frequently they are found epiphytic upon algae, sometimes in large numbers. Many spend most of the time as bottom forms, and seldom if ever enter into the plankton. It is rather difficult to define the distribution of the genus, and in some respects it might be said to be almost cosmopolitan. While it has been reported from European waters, it is observed but rarely in the English Channel and North Sea, and at infrequent intervals in the Mediterranean. The genus is more common in the North Atlantic, frequent around the coasts of Greenland, in the Hudson Bay, and the north polar seas. It does not extend southwards below 40° S to any marked degree, particularly in the Atlantic area and associated seas. It is almost entirely absent from tropical Atlantic waters, but occurs frequently, and sometimes in great numbers in tropical Pacific waters, particularly around the Philippine Islands. In the northern Pacific it is common around the coasts of Japan and California. An examination of the plankton from a long line of inshore stations in the Peru current along the west coast of South America failed to reveal any trace of the genus in the tropical and subtropical Zones. In south polar seas, however, the genus is again well represented, and is found frequently associating with the coastal flora of the islands in the South Pacific and Southern Oceans. Owing to the influence of the cold currents moving northwards, some species are found occasionally off the Cape of Good Hope.

**Trigonium arcticum (Brightwell) Cleve.** (Pl. X, fig. 1.)

Cleve, 1868, vol. XXIV, p. 663.
Mann, 1907, vol. X, p. 290.
*Triceratium arcticum* Brightwell, 1853, p. 250.
*Biddulphia arctica* (Brightwell) Boyer, 1901, p. 714.

Cells triangular in valve view, somewhat rectangular in girdle view. Valves triangular, sides straight, slightly convex or weakly concave. Angles rounded, not produced. Valve surface slightly raised or inflated in the central area, curving weakly down to the edge of the valve, where it falls sharply to the valve margin. Valve mantle straight, rather short. Valves covered with polygonal areolation. Areoles small at the centre, slightly increasing in size at half the radius, after which they decrease again. Areoles arranged in curved radiating lines, often dichotomously branched. Areolation entire over the whole surface. Areoles furnished with secondary structure upon the lower wall in the form of small poroids, open upon the inner side. Angles of valve furnished with bosses of fine pores, shaped somewhat like a thumb-mark. Bosses not produced, often lower than the central area of the valve surface. Valve mantle bearing no constriction. Girdle usually short, covered with fine puncta arranged in straight lines in the pervalvar axis. Chromatophores: numerous rounded bodies. Diameter of valve 260–340$\mu$, mostly 320$\mu$; pervalvar axis 200$\mu$.

This species is subject to great variation in size and outline. The bosses of fine pores in the angles of the valves exude short mucous stipes or cushions, by which the cell attaches itself to the substratum. A littoral diatom, not a true member of the plankton and commonly found epiphytic upon larger algae. It has been reported from most northern European coasts. The specimens obtained at St. WS 481 were unusually large, and showed little variation in size or shape.

Observed at Sts. WS 481, 622, 623.

## Genus Pseudo-triceratium Grunow

Grunow, 1884

**Pseudo-triceratium cinnamomeum (Greville) Grunow.**

Grunow, 1884, p. 83.
*Triceratium cinnamomeum* Greville, 1863, p. 232.

Valves triangular, sides straight or nearly so, with broadly rounded angles. Valve surface covered with fine punctation, somewhat irregularly arranged in the central area, but subradial towards the margin. The margin of the valve is furnished with several small but stout spinulae. The lines of puncta which radiate towards the spinulae are more prominent than the remainder. Diameter of cell 36$\mu$.

Observed at St. 434.

## Subfamily *TRICERATIOIDEAE*

### Genus Triceratium Ehrenberg

Ehrenberg, 1840*a*

The genus *Triceratium* has been attacked by many workers from time to time, but little success has attended their labours. In the main they have followed Van Heurck in condemning the genus upon the grounds that it is a collection of forms that are but triangular configurations of the genus *Biddulphia*. While it must be admitted that many species of *Triceratium* should be referred to *Biddulphia*, I can see no reason for allowing the whole genus to fall into synonymy because I recognize in the type species certain fundamental characters which separate it most definitely from all allied genera.

The genus was established in 1840, two species were described, *Triceratium favus* and *T. striolatum*, and the former is usually considered as the type. *T. favus* possesses polygonal valves; varieties possessing seven or eight sides have been found, but the type is triangular. The sides of the cell are usually straight, sometimes very slightly convex. The angles are furnished with a stout cornutate process. The valve surface is covered with a regular hexagonal loculation. The loculi are usually open upon the outer surface, while the lower wall or floor is furnished with poroids. The valve mantle is narrow. The girdle is always simple and finely punctate. Small spines are usually present on the valve surface at the point of confluence of the walls of the loculi; these are often developed at the margin of the valve and have the appearance of a palisade.

The complex structure of the valve is profoundly different from anything observed in the genus *Biddulphia*. This structure has been ably portrayed by Müller (1871) and Flögel (1884) and separates the genus *Triceratium* most clearly from all allied genera, and allows the species to be recognized instantly. Based upon this characteristic structure the genus *Triceratium* is a small, sharply defined group of highly evolved diatoms containing about twenty-seven species and varieties. The genus is a littoral one, and the species are solitary in habit. The geographical distribution is somewhat difficult to define, but may be said to be temperate to tropical.

**Triceratium favus** Ehrenberg. (Pl. X, figs. 2, 3.)

Ehrenberg, 1840*a*, p. 79 (159), pl. 4, fig. 10.
Hustedt, 1930, p. 798, figs. 462, 463.
*Triceratium comptum* Ehrenberg, 1844, p. 166.
*Triceratium muricatum* Brightwell, 1853, vol. 1, p. 249, pl. 4, fig. 5.
*Triceratium fimbriatum* Wallich, 1858, p. 247, pl. 12, figs. 4–9.
*Triceratium scitulum* Schmidt, 1885, pl. 83, fig. 11–16.
*Triceratium sarcophagus* Castracane, 1886, pl. 6, fig. 3.
*Triceratium ferox* Castracane, 1886, p. 107, pl. 6, fig. 4.
*Biddulphia favus* (Ehrenberg) Van Heurck, 1881, pl. 107, figs. 1–4, 1896, p. 475, pl. 21, fig. 643.

Cells triangular in valve view, almost rectangular in girdle view. Surface of valve covered with regular hexagonal cellulation arranged in straight lines. Angles of the valve furnished with stout cornutate processes. Valve mantle narrow, not constricted. Valve surface often covered with small spines placed upon the walls of the loculi at the point of confluence. The spines of the marginal row are often joined together to form an outer palisade or fenestrated superstructure. The girdle is simple and finely punctate. Chromatophores: numerous rounded bodies. Distance between the angles 86μ, pervalvar axis 40μ.

A littoral species frequent around the North Sea coasts and the sea-board on both sides of the Atlantic. This species was observed at one station only, off South Africa. The specimens were very few, small and by no means so elegant as those obtained from the North Sea. Type locality: Cuxhaven.

Observed at St. 436.

### Genus **Ditylum** L. W. Bailey

Bailey, 1862

The genus was described first to the Boston Society of Natural History in September of 1861, and was published in the *Proceedings* of that Society in the following year (vol. VIII, 1862) and later in the *Boston Journal of Natural History* (vol. VII, 1862), where illustrations were provided. Two species were described, *D. trigonum* and *D. inaequale*. The first, which is usually considered as the type, had been described previously by Tuffen West as *Triceratium Brightwellii* (West, 1860). It must be assumed that Bailey was unaware of West's paper.

Grunow, in Van Heurck's Synopsis (1880–5) made the combination *Ditylum Brightwellii* (West) and placed both Bailey's species as synonyms.

The generic name is often spelt wrongly as *Ditylium*. The genus was discovered by the father of the author (J. W. Bailey) in material from the Para River.

**Ditylum Brightwellii** (West) Grunow ex Van Heurck. (Pl. XII, figs. 5, 6.)

Van Heurck, 1885, p. 196.
Gran, 1905, p. 112, pl. 150.
Hustedt, 1930, p. 784, fig. 457.
Lebour, 1930, p. 186, fig. 146.
*Triceratium Brightwellii* West, 1860, p. 149, pl. 7, fig. 6.
*Ditylum trigonum* Bailey, 1862, p. 163.
*Ditylum inaequale* Bailey, 1862, p. 163.

Cells triangular in shape, somewhat like a prism, angles rounded so as to give a cylindrical appearance. Cells three to eight times longer than broad. Valves small, undulate, furnished with a corona of short but stout spines surrounding one large central spine. Central spine straight. Central area of valve often raised, hyaline. Girdle elongated. Lebour (1930) described the connecting zone as composed of scale-like intercalary bands. Chromatophores: numerous cocciform bodies, usually grouped towards the centre of the cell. Cells very weakly siliceous. Diameter of valve 28–46μ; pervalvar axis 80–130μ; length of spine 20–50μ.

A neritic species, widely distributed throughout temperate and subtropical seas. It was observed frequently around the coasts of South Africa, the Falkland Islands, and in the Pacific Ocean.

Observed at Sts. 260, 262, 436, 722, 723; WS 105, 107, 710.

**Ditylum sol** (Grunow ex Van Heurck) De Toni. (Pl. XII, fig. 4.)

De Toni 1894, p. 1018.
Hustedt, 1930, p. 787, fig. 460.
*Triceratium sol* Grunow ex Van Heurck, 1881, p. 115.

Cells triangular in valve view, rectangular in girdle view, usually solitary. Surface of valve undulate, differentiated into central and marginal areas. Central area finely punctate, puncta in curved radiating lines. A small central hyaline area present. Hyaline area surrounded by a few short blunt spines and having one long central spine. Marginal areas covered with very fine puncta in more or less parallel lines. Margin of valve crenulate. Girdle usually simple, covered with extremely fine puncta. Chromatophores: numerous cocciform bodies. Diameter of valve (length of side) 60–180$\mu$; pervalvar axis, excluding spine, 60–80$\mu$; length of central spine 60–76$\mu$.

A tropical form, probably oceanic. Occurs frequently in Atlantic Ocean, around the Cape of Good Hope and in the China Seas.

Observed at Sts. 425, 434, 440.

### Subfamily *HEMIAULOIDEAE*

### Genus **Hemiaulus** Ehrenberg

Ehrenberg, 1844*b*

**Hemiaulus Hauckii** Grunow ex Van Heurck. (Pl. XII, fig. 14.)

Van Heurck, 1880–5, pl. 103, fig. 10.
Karsten, 1906, p. 172, pl. 38, fig. 9.
Gran, 1905, p. 100, fig. 128.
Hustedt, 1930, p. 874, fig. 518.
Lebour, 1930, p. 183, fig. 143.

Cells small, bipolar, sometimes solitary, but mostly united to form long chains, often twisted. Valves elliptical, poles produced to form long thin processes. Processes straight, slightly convergent, terminated by small spines. Surface of valve slightly concave, valve mantle deep. The cells are very weakly siliceous and possess no visible structure. Chromatophores: four to six small rounded bodies.

A very common oceanic? diatom, often found in dense masses. Seldom observed north of 50° N. Very common in the Mediterranean, and off the east coast of Africa.

Observed at Sts. 425, 440, 677, 679, 681, 1373.

### Subfamily *EUCAMPIOIDEAE*

### Genus **Eucampia** Ehrenberg

Ehrenberg, 1840*a*

**Eucampia balaustium** Castracane. (Pl. XIII, figs. 8–10.)

Castracane, 1886, p. 97, pl. 18, fig. 5.
Karsten, 1905, p. 120, pl. 11, fig. 7.
*Molleria antarctica* Castracane, 1886, p. 98, pl. 18, fig. 8.

Cells united to form curved chains. Valves elliptical in outline. Valve surface flat, concave or convex. Angles produced to form stout truncate processes or bosses, one produced a little more than the other, so that the cell has a cuneate aspect in girdle view. Valve surface covered with puncta which are arranged in curved lines radiating from an eccentric spine. Connective zone sometimes wide, composed of numerous intercalary bands. The cells vary very considerably in the degree of silicification. In some specimens the cells were small and coarse, puncta large and irregularly arranged, while in the extreme southern waters the cells were very weakly siliceous and the puncta very difficult to see. Chromatophores: several small rounded bodies. Polar axis 30–66$\mu$.

A characteristic Antarctic diatom, widely distributed throughout the Southern Ocean. Very common around South Georgia and to the south of the Cape of Good Hope.

Observed at Sts. 300–305, 365, 368, 378, 379, 380, 381, 382, 386, 427, 433, 436, 440, 461, 463, 475, 480, 481, 482, 501, 505–513, 542, 544, 570, 576, 577, 580; WS 469, 474, 481, 550, 551, 552A, 709, 710; MS 86.

**Eucampia cornuta** (Cleve) Grunow ex Van Heurck. (Pl. XII, fig. 10.)

Van Heurck, 1880–5, pl. 95*b*, fig. 5.
Hustedt, 1930, p. 774, fig. 452.
Karsten, 1928, p. 237, fig. 280.
*Molleria cornuta* Cleve, 1873, p. 7, pl. 1, fig. 6.

Cells somewhat rectangular in girdle view, often curved, solitary or united to form chains. Valves narrow, elliptical, finely striate. The poles of the valve are strongly produced. Processes, truncate. The connective zone is elongated, and possesses many annular segments, segments striate. Chromatophores: numerous cocciform bodies. Apical axis 30–44$\mu$; pervalvar axis 80–140$\mu$.

An oceanic species, having a wide distribution in tropical and subtropical seas. It occurred frequently around the coast of Africa, particularly on the eastern side.

Observed at Sts. 425, 428, 436, 439, 440, 1570, 1572, 1574, 1581, 1584, 1586.

**Eucampia zoodiacus** Ehrenberg. (Pl. XII, fig. 7.)

Ehrenberg, 1840*a*, p. 151, pl. 4, fig. 8.
Hustedt, 1930, p. 772, fig. 451.
Lebour, 1930, p. 187, fig. 147.

Cells united to form flattened chains, often spirally curved. Valves face to face, narrow, elliptic-linear, minutely punctate. Valve surface depressed in the centre, leaving the processes flattened. In girdle view the depressions appear as large apertures varying in shape from narrowly lanceolate to broadly elliptical. Valve surface furnished with one small eccentric spine. Girdle composed of a number of narrow annular segments. Chromatophores: numerous rounded bodies. Polar axis 30–96$\mu$; pervalvar axis 40$\mu$.

A neritic species, commonly distributed throughout northern European waters and the Mediterranean. It was observed at one station only off the east coast of Africa.

Observed at St. 1373.

## Genus **Climacodium** Grunow

Grunow, 1870

**Climacodium biconcavum** (Ostenfeld) Cleve. (Pl. XII, fig. 13.)

Cleve, 1897 *a*, p. 22, pl. 2, figs. 16, 17.
Gran, 1905, p. 100, fig. 130.
Karsten, 1906, p. 172, pl. 38, fig. 10.
Hustedt, 1930, p. 777, fig. 454.
Lebour, 1930, p. 189, fig. 149 *b*.
*Eucampia biconcava* Ostenfeld, 1902, p. 241.

Cells somewhat rectangular, united to form flat but often twisted chains. Valves face to face. Valve surface concave, often deeply so, angles often slightly produced. When seen in girdle view, the apertures between adjacent frustules are irregularly elliptic-lanceolate. Cells very weakly siliceous, no structure visible. Chromatophores: numerous cocciform bodies, usually grouped towards the centre of the cell. Polar axis of cell 44–60$\mu$; pervalvar axis 54$\mu$.

An oceanic form widely distributed in tropical waters. Observed at one station only, off the coast of Natal.

Observed at St. 436.

**Climacodium Frauenfeldianum** Grunow. (Pl. XII, fig. 8.)

Grunow, 1870, p. 102, pl. 1, fig. 24.
Gran, 1905, p. 100, fig. 129.
Karsten, 1906, p. 394, pl. 46, fig. 5.
Hustedt, 1930, p. 776, fig. 453.
Lebour, 1930, p. 189, fig. 149 *a*.

Cells straight, united to form long flat chains, seldom twisted. Valves face to face, linear-elliptical in outline. Valve surface sharply concave, raised at the poles to form stout truncate processes. Central area flat. In girdle view, the apertures between adjacent cells are large, oblong to oval. The apertures are usually greater than the cells. Cells very weakly siliceous, no definite structure visible. Chromatophores: numerous cocciform bodies, usually grouped towards the centre of the cell. Polar axis of cell 100–180$\mu$; pervalvar axis 14–28$\mu$.

An oceanic species having a wide distribution in tropical and subtropical seas. Frequently encountered around the coasts of Africa, particularly on the Indian Ocean side.

Observed at Sts. 425, 428, 440, 1373, 1570, 1572, 1584, 1586.

## Genus **Streptotheca** Shrubsole

Shrubsole, 1890

**Streptotheca thamesis** Shrubsole. (Pl. XII, fig. 11.)

Shrubsole, 1890, p. 260, pl. 13, figs. 4-6.
Hustedt, 1930, p. 779, fig. 455.
Lebour, 1930, p. 190, fig. 150.
Gran, 1905, p. 101, fig. 131.

Cells rectangular, almost square, united to form long flat ribbon-like chains, twisted about the pervalvar axis. Adjacent valves adhering closely, leaving no aperture. Valve linear in outline, valve surface often showing a small prominence which fits into a corresponding depression upon the neighbouring cell. Chromatophores: numerous small rounded bodies, which are arranged in a number of lines radiating from the central nucleus. Cells very weakly siliceous, completely soluble in mineral acids and absorbing dyes readily. Polar axis of cell 80–100$\mu$; pervalvar axis 90–120$\mu$.

A neritic species, having a wide distribution in temperate and subpolar seas. It was observed frequently in the Peru Current material.

Observed at Sts. WS 709, 710.

## Family ANAULACEAE

### Subfamily *ANAULOIDEAE*

### Genus **Anaulus** Ehrenberg

Ehrenberg, 1844*b*

The exact position of this genus is very uncertain. The bipolarity of the cells suggests relationship with the Biddulphiaceae, particularly with the genera *Eucampia* and *Eunotogramma*, but the entire absence of surface spines and the loculate valve surface have prompted systematists to separate them. I have placed the Anaulaceae immediately after the Eucampioideae, between it and the Chaetoceraceae; to the latter it bears no resemblance except of course in the bipolarity of the cell. Microspores and resting spores are unknown in *Anaulus*. The genus has been placed by some authors immediately preceding the Araphidineae, but in the systematic arrangement I have adopted, this course would bring *Anaulus* next to *Corethron* to which it bears no relationship whatever. It is very doubtful whether a separate family is necessary for this genus, but in view of the uncertainty which exists concerning its exact relationship to the genera of the Biddulphiaceae this course seems preferable.

The genus is neritic; the cells, united by means of mucous pads, are usually epiphytic on larger algae. The genus is distributed in both warm and cold water.

**Anaulus ellipticus** Hendey, sp.nov. (Pl. IX, figs. 4–13.)

*Frustulis* in catenis 3–8 conjunctis, e facie connectivali visis rectangularibus; *cingulis* multiplicibus; *valvis* ellipticis vel late ovalibus, superficie lenissime convexa; *septis* validis 2–6, in marginem crassam confluentibus; *punctis* subtilissimis, in lineis subradiantibus in medio dispositis, alibi irregularibus.

*Mensura valvarum* 70–110 × 35–50$\mu$.

*Hab.* in aquis marinis "Bransfield Strait", prope insulam "Astrolabe" dictam, in oceano Antarctica.

*Typus* in Herb. Mus. Brit. No. 33962.

A meroplanktonic species associated with *Anaulus scalaris*, from the Bransfield Strait. It is much smaller than that species and different in outline. Repeated attempts to establish a chain of intermediate forms that would allow one to unite them under one name were unsuccessful, in spite of the similarity of structure.

The punctation upon the valve surface was very much finer than in *Anaulus scalaris*, and in some specimens appeared to be absent altogether from some of the loculi. The plicate connective zone was strongly developed and very much deeper than in Ehrenberg's species. In the specimens examined the photosynthetic elements were indiscernible. The cells were united at one angle only by a short mucous thread or cushion, forming small spirally arranged filaments.

Observed at St. WS 481.

**Anaulus scalaris** Ehrenberg.

In H. van Heurck, 1909, p. 35, pl. 8, figs. 108, 109.

Cells elongated, very robust. Valves narrowly elliptical with broadly rounded apices. The extremities of the valve are furnished with large ocelli, shaped somewhat like a thumb-mark. Ocelli only very slightly raised above the surface of the valve. Valve surface almost flat, furnished with numerous transverse bars, usually eight to twenty, which divide the valve into almost equal compartments, those towards the apices usually a little smaller than the central ones. These compartments are covered with a very fine striation, which has a tendency to subradial arrangement. Cell in girdle view rectangular, connective zone simple. Apical axis of cell 200–300$\mu$; transapical axis 26–40$\mu$.

Observed at St. WS 481.

## Family CHAETOCERACEAE

### Subfamily *CHAETOCEROIDEAE*

1. Cells bipolar, hyaline, each angle furnished with one long bristle ... ... *Chaetoceros*

### Genus **Chaetoceros** Ehrenberg

Ehrenberg, 1844

*Chaetoceros* is the largest of the truly planktonic genera, containing approximately 160 species. The majority of them are neritic, and the classification depends upon the form of the cell, the number and position of the chromatophores, the form of the foramina or intercellular apertures, and the structure of the characteristic appendages. Great confusion has been caused because of the difference in appearance exhibited by the same species from different localities, and at different seasons of the year. The production and identity of so-called winter forms and summer forms is very difficult to appreciate unless intermediates are available to complete the gradation—so different are the extremes that they may be taken for totally different species.

Members of the genus may be solitary, but usually they are colonial, and are to be found matted together in very dense populations. Some small species form mucilaginous colonies, particularly in cold waters. The genus is spread equally through warm and cold seas; generally speaking it is found that tropical species are relatively large in the body of the cell, and possess small and thin appendages, while polar species are very much reduced in the size of the cell, and possess relatively large and complex appendages.

The gender of the generic name has been changed by authors from time to time, Hustedt, Gran, Lebour and Cleve have considered it as masculine and have terminated the specific epithets accordingly. Castracane and Karsten followed Ehrenberg in making *Chaetoceros* a neuter noun. The generic name is used here in the gender ascribed to it by its author.

### Subgenus **Phaeoceros**

### Section ATLANTICA

**Chaetoceros atlanticum** Cleve.

Cleve, 1873 *b*, p. 11, pl. 2, fig. 8.
Gran, 1905, p. 64, fig. 74.
Hustedt, 1930, p. 641, fig. 363.
Karsten, 1905, p. 115, pl. 15, fig. 9
Lebour, 1930, p. 111, fig. 77.
*Chaetoceros dispar* Castracane, 1886, p. 76, pl. 8, fig. 6.
*Chaetoceros audax* Schütt, 1895, p. 47, pl. 5, fig. 25.
*Chaetoceros polygonum* Schütt, 1895, p. 46, pl. 5, fig. 24.

Cells united to form chains, chains stiff, straight, not twisted. Cells in girdle view rectangular. Valve mantles deep, divided from girdle by a small but definite constriction, giving the appearance of lines running around the cell dividing it into three more or less equal zones. Surface of valve flat, oblong-elliptic in outline, margins curved, furnished with a small central spine. Bristles strong, stiff and straight, emanating from the surface of the valve just above the valve mantle. Terminal bristles usually shorter than the others, strongly siliceous, approximating the pervalvar axis. Bristles bearing lines of fine dots and small indefinite spines. Foramina varying considerably in size, somewhat rectangular in shape, usually large. Chromatophores: numerous small rounded bodies penetrating the bristles. Diameter of valve, polar axis 20–46$\mu$.

A very common oceanic species, widely distributed in north polar waters, extending southwards through all European seas. Less frequent in tropical seas, common in south temperate seas, but seldom found in Antarctic waters. The species prefers high salinity. It was found frequently around the coast of South Africa, and South Georgia.

Observed at Sts. 262, 365, 368, 369, 378, 379, 380, 381, 382, 383, 384, 386, 387, 388, 428, 451, 460, 475, 477, 505, 509, 510, 513, 681; WS 707.

**Chaetoceros atlanticum var. neapolitana** (Schröder) Hustedt.

Hustedt, 1930, p. 645, fig. 366.
*Chaetoceros neapolitanum* Schröder, 1900, p. 29, pl. 1, fig. 4.

Cells united to form chains, very similar to the type species, but much narrower. Valves almost circular, small central spine present, often seen only with difficulty.

Bristles proceeding from valve surface in the manner of the type, but continuing for a short distance almost parallel with the pervalvar axis before turning outwards to cross the bristles of the neighbouring cells. Bristles sometimes slightly curved back. Foramina varying considerably, often oblong in shape with the long axis in the pervalvar plane, but sometimes diamond-shaped. Chromatophores: numerous cocciform bodies, penetrating the bristles. Diameter of valve 8–12μ; pervalvar axis up to 20μ.

A small oceanic form, preferring temperate and subtropical water. It was observed frequently around the coast of Africa, sometimes mixed with the type.

Observed at Sts. 368, 427, 428, 435, 439, 1373, 1586; WS 550.

**Chaetoceros dichaeta** Ehrenberg. (Pl. VI, figs. 9, 10.)

Ehrenberg, 1844, p. 200.
Gran, 1905, p. 66, fig. 77.
Mangin, 1915, p. 37, figs. 17–26.
Van Heurck, 1909, pl. 5, figs. 78–82.
Hustedt, 1930, p. 648, fig. 367.
*Chaetoceros remotus* Cleve et Grunow, 1880, p. 120.
*Chaetoceros Janischianum* Castracane, 1886, p. 77.

Cells united to form chains. Chains straight and stiff. Valves elliptical to circular, convex, bearing a sharp central spine. Valve mantle narrow. Bristles emanating from well inside the valve margin and proceeding upwards in a direction parallel with the pervalvar axis for a considerable distance to meet the bristles of the next cell. At the point of contact the bristles turn outwards parallel with the apical plane of the valve. The bristles on the lower valve of a terminal cell emerge somewhat obliquely at first, but later are bent towards the chain axis. Girdle very narrow, indistinct. Foramina varying considerably; in some specimens they appear to be almost diamond shape, while in others almost hexagonal, usually large. Lengths of connective tissue are frequently observed between the cells. Chromatophores: numerous small plates or cocciform bodies, penetrating the bristles. Diameter of valve 20–50μ.

An oceanic species, having a wide distribution in the southern hemisphere. It was observed very frequently around the coast of South Africa, South Georgia and along the east coast of Africa. Very common throughout the Southern Ocean, but not in the extreme south.

Observed at Sts. 365, 368, 369, 378–386, 425, 427, 428, 433, 452, 453, 460, 461, 463, 560, 574, 577, 580, 666, 1356, 1358, 1359.

**Chaetoceros cruciatum** Karsten.

Karsten, 1905, p. 116, pl. 15, fig. 5.

Cells united to form short chains, usually four to eight cells in a chain; sometimes solitary. Cells rectangular in girdle view. Valves elliptical, valve surface with slight medium inflation, surmounted by a sharp spine. Bristles emerging well inside the girdle, almost half way between the girdle and the median spine, and proceeding outwards obliquely. Strongly divergent, diagonal, alternate and opposite bristles of each cell in the chain cross the corresponding bristles of the neighbouring cells at an angle of about

90°. Bristles short, stiff and straight, slightly inflated through the major part of their length, but tapering to a sharp point. Valve mantle and girdle about the same depth, defined by small constrictions at the points of juncture. Foramina somewhat large, hexagonal. Chromatophores: numerous small bodies, which penetrate the bristles. Diameter of valve, polar axis 20μ.

Probably a neritic species, common in the Antarctic. It belongs to the *C. atlanticum* group. It was observed frequently around South Georgia and Cape Horn.

Observed at Sts. 378, 379, 380, 382, 460, 461, 477, 478, 505.

### Section Borealia

**Chaetoceros boreale** Bailey.

Bailey, 1855, p. 8.
Lebour, 1930, p. 117, fig. 83.

Cells united to form short straight chains. Valves slightly convex, elliptical. Bristles emanating from the valve surface above and within the valve mantle. Valve mantle rather deep, straight. Connective zone very narrow. Bristles after crossing, tending to be almost parallel. The bristles become thicker as they proceed outwards, and are often covered with spines. Cells rectangular in girdle view, somewhat oblong, with the long axis in the apical plane. Foramina distinct, but often narrow. Chromatophores: numerous rounded bodies, penetrating the bristles. Diameter of valve, polar axis 30–48μ; pervalvar axis 15–30μ.

An oceanic species, with a wide distribution in subpolar and temperate seas of the northern hemisphere. Observed in small numbers around South Georgia.

Observed at Sts. 505, 509.

**Chaetoceros Glandazi** Mangin.

Mangin, 1910, p. 346, fig. 2.
Lebour, 1930, p. 118, fig. 84.

Cells united to form straight chains, rectangular in girdle view. Valves almost circular, with a slightly convex surface, bearing a small median process which meets and fuses with the corresponding process of the neighbouring cell. Bristles long and straight, not emerging altogether from the apices of the valve in the manner common to this genus, but being more or less continuations of the valve surface, sweeping across the axis of the chain from opposite sides. That is, when the chain is lying flat, the bristles on the right side of the chain emerge from the left side of the cells, and those which appear on the left side of the chain emerge from the right of the cells. The foramina are difficult to define, but appear diamond-shaped crossed by the median processes of the valves. The bristles upon the lower valve of a terminal cell bear very short spines, the others are plain. Chromatophores: numerous cocciform bodies, penetrating the bristles. Diameter of valve 26μ; pervalvar axis 34μ.

An unmistakeable species, having a restricted distribution in temperate seas, probably neritic. Observed in small numbers off the east African coast.

Observed at St. 1373.

**Chaetoceros coarctatum** Lauder. (Pl. VI, figs. 7, 8.)

Lauder, 1864, p. 79, pl. 8, fig. 8.
Gran, 1905, p. 68, fig. 80.
Karsten, 1905, p. 120, pl. 16, fig. 6.
Hustedt, 1930, p. 655, fig. 370.
Lebour, 1930, p. 119, fig. 85.
*Chaetoceros rudis* Cleve, 1901, p. 308.

Cells united to form short chains of usually twelve to sixteen cells. Valves elliptical to circular, strongly siliceous. Valves adpressed, no distinct foramina present. Valve mantle usually deep, often a little deeper than the connective zone. Bristles coarse, emanating from the margin of the valve. Bristles proceeding outwards in different planes, almost perpendicular to the axis of the chain for a short distance and then strongly curved downwards, often recurved, crossing the pervalvar axis. Bristles usually thickest at about half their length, often bearing faint ribs and strong spines throughout their entire length. Terminal bristles usually very strong and convergent. Chromatophores: numerous cocciform bodies. Diameter of valve 30–40μ.

An oceanic species having a wide distribution in tropical and subtropical seas. It was observed frequently around the coast of Africa, particularly on the Indian Ocean side, and in the Peru Current material from the Pacific.

This species is very liable to parasitism, and it is rather remarkable to note that although the specimens examined were obtained from areas widely separated, every one without exception was heavily infested by *Vorticella oceanica* Zach. This is probably a case of symbiosis. The diatom cells were very healthy and the cell contents did not appear to have suffered as a result of the association.

Observed at Sts. 293, 670, 681, 1373, 1584; WS 709, 710, 714.

**Chaetoceros convolutum** Castracane.

Castracane, 1886, p. 78.
Gran, 1905, p. 69, fig. 82.
Meunier, 1910, p. 218, pl. 24, figs. 17–19.
Hustedt, 1930, p. 668, fig. 378.
Lebour, 1930, p. 119, fig. 86.

Cells united to form chains, usually curved or slightly twisted. Valves dissimilar, almost circular; the upper rounded, the lower flat. Valve mantle almost as deep as the girdle and clearly defined by a small sharp constriction at the point of juncture. Bristles long, thin, but strong. Those of the upper valve arise near the centre, those of the lower valve emanate from near the valve margin, and appear to lie closer to the axis of the chain than do those of the upper valve. Bristles armed with short but distinct spines throughout their entire length. All bristles are bent towards the lower end of the chain. The bristles of the lower valve of the terminal cell often converge and cross. Foramina small, frequently obscure. Chromatophores: numerous small rounded bodies, nucleus central. Diameter of valve 15–30μ.

This species is very common in the Atlantic and northern European seas.

Observed at Sts. 440, 690; WS 100.

**Chaetoceros danicum** Cleve.

Cleve, 1889, p. 55.
Lebour, 1930, p. 124, fig. 89.

Cells usually solitary, but sometimes in short chains of three to eight cells. Valve surface flat, oval in outline. Valve mantle deep, bristles thin, almost straight, emanating from the margin of the valve, perpendicular to the pervalvar axis. The bristles of the upper valve are often almost at right angles to those of the lower valve. Foramina much reduced, almost absent. Chromatophores: numerous cocciform bodies, nucleus seldom central. Diameter of valve 16–20$\mu$.

A small neritic species having a very wide distribution. Common in European waters and in the Atlantic and Indian Oceans. Observed at one station only off the coast of Africa.

Observed at St. 1373.

**Chaetoceros aequatoriale** Cleve.

Cleve, 1873 *a*, p. 10, pl. 2, fig. 9.
Karsten, 1907, p. 389, pl. 45, fig. 1.

Cells usually solitary, rectangular in girdle view, with rounded angles. Valves almost circular in outline, with a slightly convex surface, rounded at the margin. Valve mantles sharply constricted immediately above the girdle, girdle narrow. Bristles long, very strong, emerging almost from the centre of the valve, proceeding outwards almost at right angles to the pervalvar axis, then sweeping downwards in shapely curves converging towards their extremities. The bristles of the upper valve almost parallel with those of the lower throughout the entire length. The bristles are thick at the point of emergence, tapering gently. They are marked with longitudinal ridges and transverse striation, are somewhat angular in cross section, and armed with small spines throughout their entire length. Chromatophores: numerous rounded bodies. Diameter of valve 25$\mu$.

An oceanic species, widely spread throughout the Indian Ocean. It was observed frequently around South Africa and to the south of Madagascar.

Observed at Sts. 425, 427, 433, 435, 440, 1570, 1572, 1574.

**Chaetoceros curvatum** Castracane.

Castracane, 1886, p. 77.
Mangin, 1915, p. 36, figs. 15, 16.

Cells usually solitary, but sometimes united in short chains of two to six cells. Valves dissimilar. Valve surface elliptical to circular in outline, the upper convex, the lower either flat or concave. The valve mantle of the upper valve greater than that of the lower. Bristles usually short and somewhat tortuous, particularly those on the lower valve. The bristles emerge from the centre of the upper valve, and are bent so as to hang in a more or less pendulous fashion almost parallel with the bristles of the lower valve, which also emerge from the centre of the valve. The bristles of the upper valve originate as two separate diverging appendages, and are not fused together to make the surface of the upper valve flat, as in *Chaetoceros criophilum* Castracane. Chromatophores: several small bodies. Diameter of valve in the polar axis 15–36μ; pervalvar axis of cell 10–15μ.

This species was observed occasionally around the coasts of South Africa.

Observed at Sts. 425, 427, 440.

**Chaetoceros pendulum** Karsten.

Karsten, 1905, p. 118, pl. 15, fig. 7.

Cells solitary, sometimes three or four are matted together but not united to form chains. Valves elliptical in outline. Valve surface concave, that of the upper valve more so than the lower. Bristles emerging just inside the girdle line. The bristles of both valves proceed in the same direction, obliquely at first, then curving almost parallel with each other and with the pervalvar axis of the cell. Bristles long, pendulous, smooth. Chromatophores: numerous small cocciform bodies penetrating the bristles. Diameter of valve 18–28μ.

A neritic form common in the South Atlantic Ocean. It was observed between the South Shetlands and Cape Horn, but never in great numbers.

Observed at Sts. 378, 379, 380, 382, 383, 384, 451.

**Chaetoceros Castracanei** Karsten.

Karsten, 1905, p. 116, pl. 15, fig. 1.

Cells united to form chains, six to twenty cells in a chain, cells rectangular in girdle view. Valve elliptical in outline, central area slightly inflated. Angles of valve produced to form stout, stiff bristles, which proceed in straight lines at right angles to the axis of the chain. The bristles are armed with small spines throughout the greater part of their length, but are smooth near the point of emergence. The valves of one cell almost touch those of the neighbouring cells; the foramina therefore are much reduced, almost absent. Valve mantle deep, gently constricted as it meets the connective zone. Girdle rather narrow. Chromatophores: numerous small oval bodies, penetrating the bristles. Diameter of valve 20–25μ.

A neritic species, observed in great numbers off Cape Horn, very common in the Antarctic.

Observed at Sts. 378, 379, 380, 382, 383.

**Chaetoceros criophilum** Castracane. (Pl. XIII, fig. 7.)

Castracane, 1886, p. 78.
Karsten, 1905, p. 118, pl. 15, fig. 8.
Mangin, 1915, p. 34, figs. 13, 14.

Cells united to form short chains, but often solitary. Valves dissimilar. Valve surface almost circular, the upper strongly convex, with deep valve mantle, the lower almost flat, with narrow valve mantle. Bristles very long, with sweeping curves. The bristles of the upper valve emerge from the centre as part of the valve surface, while those of the lower valve emerge from a point nearer the valve margin. Bristles armed with small spines throughout their entire length. The bristles upon the lower valve of a terminal cell are directed parallel with the axis of the chain, but are directed obliquely if the cell is solitary. Chromatophores: several small rounded bodies. Diameter of valve 16–50μ.

A characteristic Antarctic diatom, found in enormous quantities around South Georgia, in the Weddell Sea, the Bellingshausen Sea, and the Ross Sea. This species, together with *Corethron criophilum* Castracane, often amounts to over 90 per cent of the total phytoplankton in some areas in the extreme south.

Observed at Sts. 301, 368, 369, 378, 379, 380, 381, 382, 383, 384, 386, 388, 425, 432, 460, 461, 463, 475, 477, 478, 479, 480, 481, 482, 501–513, 551, 570, 574, 575, 576, 577, 578, 580, 615, 619, 626, 659, 661, 663, 664, 666, 1356, 1358, 1359, 1362; WS 101, 104, 474, 540, 541, 545, 547, 548, 549, 550, 551, 552A, 569, 571, 580, 593, 594, 598, 600, 602; RS 9, 17, 27; MS 86, 88, 94, 99, 100, 103.

**Chaetoceros peruvianum** Brightwell. (Pl. XIII, fig. 6.)

Brightwell, 1856, p. 107, pl. 7, figs. 16–18.
Gran, 1905, p. 70, fig. 84.
Karsten, 1906, p. 166, pl. 31, fig. 4.
Hustedt, 1930, p. 671, fig. 380.
*Chaetoceros peruvio-atlanticum* Karsten, 1907, p. 385, pl. 43, fig. 1.

Cells sometimes united to form short chains, but mostly solitary. Valves elliptical, dissimilar, the upper slightly convex, the lower flattened. Valve mantles deep, constricted sharply as they reach the girdle; girdle narrow. The bristles are long and stiff. Those of the upper valve emerge more or less from the centre, and occupy most of the valve surface, abutting each other at the point of emergence, reducing the actual central area of the valve to a small globiform opening. These upper bristles continue somewhat obliquely in long sweeping curves. The bristles of the lower valve emerge obliquely and continue more or less in a direction parallel with the pervalvar axis of the cell or the axis of the chain. There is a small spine upon the valve surface of the lower valve, occupying a median position. The bristles are striate, and armed with small spines. Chromatophores: several rounded bodies. Diameter of valve, polar axis 10–44μ.

A very variable oceanic species, widely distributed throughout temperate and tropical seas. It was observed frequently around the coast of South Africa, off the Falkland Islands, and in great numbers in the Pacific material from the Humboldt Current.

A number of forms and varieties have been established based upon the depth of the valve mantle, and the degree of obliquity and thickness of the bristles. Owing to the variability of the characters upon which these forms and varieties are based I find that these subspecific ranks served no useful purpose, as the enormous amount of material at my disposal provided every intermediate gradation.

Observed at Sts. 260, 425, 427, 428, 432, 433, 434, 435, 437, 438, 439, 440, 450, 453, 664; WS 100, 593, 594, 598, 600, 601, 666, 703, 709, 715, 716.

**Chaetoceros seychellarum** Karsten.

Karsten, 1907, p. 387, pl. 43, fig. 4.

Cells united to form chains. Valves elliptical in outline. Bristles emerge well inside the valve margin and proceed at right angles to the chain axis for a short distance, then sweep downwards converging slightly towards the posterior end of the chain. Neighbouring cells seem to coalesce at the point where the bristles emerge causing the foramina to have a rectangular appearance. Valve mantle deep, constricted as it meets the connective zone. Girdle deep, usually twice as deep as the valve mantle. Bristles armed with fine spines. Chromatophores: numerous small oval bodies extending into the bristles. Diameter of valve, polar axis 20–30μ; pervalvar axis 36–70μ.

A tropical and subtropical form, fairly common in the Indian Ocean. It was observed occasionally off the coast of South Africa.

Observed at Sts. 425, 433, 440.

**Chaetoceros sumatranum** Karsten.

Karsten, 1907, p. 388, pl. 45, fig. 2.
Ikari, 1928, p. 251, fig. 6.

Cells united to form short chains, usually four to ten cells in a chain. Cells somewhat cylindrical, valves almost circular, valve surface slightly concave. Bristles long, emerging well inside the valve margin, and proceeding obliquely in almost straight lines, seldom if ever converging towards the axis of the chain. Bristles armed with small spines. Valve mantle deep, slightly constricted as it meets the connective zone. Girdle also deep. Foramina small, narrowly elliptical. Chromatophores: numerous vermiform bodies. Diameter of valve 30–36μ; pervalvar axis 100–120μ.

A large tropical and subtropical form, common in the Indian Ocean. It was observed at one station only off South Africa.

Observed at St. 425.

**Chaetoceros Chunii** Karsten.

Karsten, 1905, p. 117, pl. 15, fig. 4.

Cells small, united to form short chains. Valves elliptical, valve surface slightly concave. Angles produced to form long thin bristles. Bristles straight and smooth. All bristles bent towards the posterior end of the chain. The bristles upon the lower valve of each cell form a more acute angle than do those of the upper valve. Valve mantle deep, constricted towards the connective zone, girdle narrow. Foramina small, elliptic-oval. Chromatophores: numerous small bodies, penetrating the bristles. Diameter of valve 12–15μ.

A small neritic species, very common in the Antarctic, seldom found N. of 40° S. It was observed very frequently around South Georgia, Cape Horn, South Shetlands and in the Bellingshausen Sea.

Observed at Sts. 378, 379, 380, 382, 478, 479, 480, 481, 482, 501, 506, 508, 574; WS 104, 545.

**Chaetoceros radiculum** Castracane.

Castracane, 1886, p. 79.
Karsten, 1905, p. 117, pl. 15, fig. 3.

Cells usually solitary, but may form short chains. In the solitary forms the cells in girdle view appear somewhat octagonal. Valve surface flat, with small median inflation. The valve mantle slopes obliquely to the connective zone. Bristles emerge within the edge of the valve and proceed in a direction parallel with the pervalvar axis of the cell. Bristles short, rotund, apiculate-globiform. At the point of emergence the bristles are strongly inflated and continue gradually narrowing to an attenuated apex, apices slightly convergent. When in chain formation these globiform bristles are found only upon the lower valve of the terminal cell. The bristles of the other cells are somewhat thickened at the point of emergence, but taper gradually to a fine point. All bristles in the chain are directed towards the posterior end of the chain. Chromatophores: numerous short vermiform bodies penetrating the bristles. Diameter of valve 40–46$\mu$.

The majority of the specimens observed were of the solitary type. A characteristic diatom of the southern seas, probably found only in cold water. It was observed fairly frequently between the South Shetlands and Cape Horn.

Observed at Sts. 383, 384, 453, 480.

**Chaetoceros Schimperianum Karsten.** (Pl. XIII, figs. 13, 14.)

Karsten, 1905, p. 117, pl. 15, fig. 2, pl. 16, fig. 4.

Cells usually united to form short chains, three to twelve cells in a chain, sometimes solitary. Valves elliptical, valve surface flat but may be weakly concave. Bristles emerge well inside the girdle, and proceed obliquely for a short distance and then continue almost at right angles to the chain axis. Bristles a little swollen at the point of emergence but taper to hair-like extremities. The bristles undulate gently, often appearing to cross those of the neighbouring cell, not only at the place of emergence, but sometimes at one or even two other points, often at a point midway between the cell and the tip of the bristle, and sometimes after crossing the bristles again converge and may meet and cross again at the extremities. Foramina narrow, hexagonal. Chromatophores: numerous small cocciform bodies penetrating the bristles. Diameter of valve 12–20$\mu$.

A neritic form characteristic of the Antarctic Ocean, probably never extending north of 45° S. Favours low salinity and cold water. It was observed, but never in great numbers, around South Georgia and in the Weddell Sea.

Observed at Sts. 478, 479; WS 550, 551, 552A.

### Subgenus *Hyalochaete*

### Section OCEANICA

**Chaetoceros decipiens Cleve.**

Cleve, 1873 *b*, p. 11, pl. 1, fig. 5.
Gran, 1905, p. 74, fig. 88.
Meunier, 1910, p. 219, pl. 25, figs. 12–17.
Hustedt, 1930, p. 675, fig. 383.
Lebour, 1930, p. 126, fig. 91.
*Chaetoceros Grunowii* Schütt, 1895, p. 43, pl. 4, fig. 14.

Cells united to form long, stiff and usually straight chains. Cells in girdle view rectangular, elliptical in valve view. Valve surface flat, or nearly so. Poles of the valve slightly produced, bearing the long stiff bristles. The bristles of one cell fuse with those of the neighbouring cell and proceed thus for a short distance, perpendicular to the pervalvar axis, but soon separate and diverge in straight lines. The bristles of the lower valve of a terminal cell are usually much stouter than the others; they emerge obliquely at first, but become bent towards the axis of the chain until they are almost parallel. Most of the bristles bear very small puncta, particularly towards the extremities. The foramina vary in shape and size according to the season, linear-lanceolate in the summer, broadly elliptical in autumn and winter. Chromatophores: several rounded bodies, usually six to ten. Diameter of valve, polar axis 30–80$\mu$.

An oceanic species having a wide distribution. Usually regarded as Arctic or sub-Arctic, being recorded from the north Atlantic and all north European seas. It was observed however in considerable quantities all around the coast of South Africa, in the Brazil Current, and in the Peru Current.

Observed at Sts. 261, 427, 428, 432, 433, 434, 435, 437, 438, 439, 666, 675, 722, 723, 1373; WS 700, 701, 703, 704, 706.

### Section DICLADIA

**Chaetoceros Lorenzianum** Grunow.

Grunow, 1863, p. 157, pl. 5, fig. 13.
Hustedt, 1930, p. 679, fig. 385.
Karsten, 1906, p. 167, pl. 31, fig. 6.
Lebour, 1930, p. 128, fig. 93.
*Chaetoceros cellulosum* Lauder, 1864, p. 78.

Cells united to form short chains, but often solitary, rectangular in girdle view. Valves elliptical in outline, central area flat or slightly convex. Valve mantle usually deep, connective zone narrow. Angles of valve slightly produced to the long stiff bristles, which cross those of the neighbouring cells at the point of emergence, proceeding in straight lines from the cells, diverging slightly. Terminal bristles usually stronger than the others, divergent. All bristles very slightly swollen in the second half of their length, that is the length farthest from the cells, but the terminal ones more so. Bristles punctate. Foramina hexagonal to elliptical. Chromatophores: usually eight to twelve large plates. Diameter of valve in the polar axis 44–60$\mu$.

A neritic species, very abundant in warm waters. It was observed at many stations in the Peru Current, sometimes in great numbers, often amounting to over 90 per cent of the total.

Observed at Sts. 666; WS 580, 594, 629, 640, 641, 642, 646, 647, 648, 649, 650, 709, 710.

**Chaetoceros buceros** Karsten.

Karsten, 1907, p. 390, pl. 44, fig. 1.

Cells united to form long chains. Valves elliptical in outline, surface concave; angles produced slightly, somewhat truncate, firmly abutting those of the neighbouring cells. Bristles rather thin, emerging from the angles, obliquely, weakly curved, slightly divergent. The lower valve of a terminal cell is differentiated. The valve surface is slightly convex, and the bristles are large and thick. The bristles emerge from the angles of the valve obliquely; they are somewhat curved, diverging until in a position almost at right angles to the axis of the chain, where they are bent suddenly towards the chain axis, and, converging slightly, their extremities are again bent in a direction parallel with the axis of the chain. These terminal bristles are somewhat flattened, and bear a few extremely fine spines. Foramina oval-elliptical. Chromatophores: numerous short vermiform bodies. Diameter of valve 40μ.

An oceanic species, common in the Indian Ocean. It was observed occasionally around the coast of South Africa.

Observed at Sts. 425, 427, 428, 438.

**Chaetoceros capense** Karsten.

Karsten, 1906, p. 167, pl. 31, fig. 7.

Cells small, united to form chains, four to eight cells in a chain. Valve elliptical in outline, valve surface concave, angles produced to form long thin bristles. Valve mantle deep, sharply constricted as it joins the connective zone. Girdle also deep, pervalvar axis usually twice the apical axis. Foramina broadly elliptical. Chromatophores: four irregular plates. Diameter of valve 10–18μ; pervalvar axis 34μ.

A small oceanic species, common around the coast of South Africa.

Observed at Sts. 431, 434, 435, 436, 437, 438.

### Section COMPRESSA

**Chaetoceros compressum** Lauder.

Lauder, 1864, p. 78, pl. 8, fig. 6.
Hustedt, 1930, p. 684, fig. 388.
Lebour, 1930, p. 132, fig. 96.

Cells united to form short chains, often twisted. Valves oval-elliptical to circular, valve surface flat or slightly convex. Cells in girdle view rectangular, often almost square. Bristles emanating from the valve surface close to the margin of the valve, bristles thin and often straight; occasionally bristles are noticed which are much stronger and thicker than the others, they are wavy and bear short spines, and are bent back towards the axis of the chain. Foramina usually small, narrow. Chromatophores: numerous small rounded bodies. Diameter of valve 20–30μ.

Usually regarded as a boreal species, having a wide distribution in northern European waters. It was observed in small numbers off the coast of Africa.

Observed at Sts. 383, 427, 428, 434, 1356, 1358.

### Section PROTUBERANTIA

**Chaetoceros didymum** Ehrenberg.

Ehrenberg, 1845, p. 75.
Gran, 1905, p. 79, fig. 94.
Karsten, 1906, p. 168, pl. 32, fig. 11.
Lebour, 1930, p. 133, fig. 97.

Cells united to form straight chains. Valves elliptical in outline, surface slightly concave with a very prominent semicircular median inflation or knob. Angles of the valves very slightly produced, giving rise to the bristles, which meet those of the neighbouring cell usually a very short distance beyond the valve margin. Bristles often curved, those of the terminal cell are usually a little stouter than the others, and bear very small spines. A very variable species. Chromatophores: two large plates, lying close to the valves. Foramina varying considerably in shape, usually elliptical, sometimes broadly oval, penetrated on the upper and lower sides by the mammiform processes upon the opposing valve surfaces. Diameter of valve, polar axis 10–48$\mu$.

A neritic species widely distributed in temperate seas. It was observed frequently around the coast of South Africa, and in the Pacific material from the Peru Current.

Observed at Sts. 260, 262, 425, 427, 428, 433, 434, 435, 437, 438, 507; WS 700, 710, 714, 715.

### Section LACINIOSA

**Chaetoceros laciniosum** Schütt.

Schütt, 1895, p. 38, fig. 5.
Gran, 1905, p. 82, fig. 99.
Meunier, 1910, p. 235, pl. 26, fig. 24.
Hustedt, 1930, p. 701, fig. 401.
Lebour, 1930, p. 137, fig. 100.

Cells united to form straight chains, usually four to twelve cells in a chain. Cells in girdle view rectangular, angles rounded. Valves elliptical in outline, slightly convex. Bristles emerging from the apices of the valve, proceeding upwards parallel with the chain axis to meet those of the neighbouring cell, which are crossed in line with the margin of the valve, and then turn outwards in sweeping curves. The bristles of the lower valve of a terminal cell are often bent as they emerge from the cell, causing them to cross, or to converge considerably. These terminal bristles are much longer and stouter than the others and are armed with short spines. Foramina rectangular. Chromatophores: two large plates, adpressed to the valves. Diameter of valve, polar axis 30–38$\mu$.

A neritic species having a wide distribution in the north Atlantic and north European seas. It was observed at one station only on the 30th W meridian.

Observed at St. 666.

**Chaetoceros pelagicum Cleve.**

Cleve, 1873 *b*, p. 11, pl. 1, fig. 4.
Gran, 1905, p. 83, fig. 101.
Hustedt, 1930, p. 704, fig. 402.

Cells rectangular, small, united to form short straight chains, sometimes solitary. Valves flat or nearly so, elliptical. The bristles emerge from the poles of the valve and proceed in the direction of the axis of the chain to meet the bristles of the neighbouring cells in line with the margin of the valve, then turning sharply outwards. Bristles long and thin for the most part, slightly divergent. Valve mantle usually deep, connective zone narrow. Foramina almost rectangular, usually as large as the cells. The bristles of the lower valve of a terminal cell diverge slightly upon emerging, then continue almost parallel with the axis of the chain, converging slightly towards their termini. Chromatophore: one small plate. Diameter of valve, polar axis 8–10$\mu$.

This species is often united with *C. laciniosum*, but I separate them upon histological grounds. The species has a distribution similar to that of *C. laciniosum*. It was observed at one station only off the coast of South Africa.

Observed at St. 451.

## Section DIADEMA

**Chaetoceros breve Schütt.**

Schütt, 1895, p. 38, fig. 4.
Gran, 1905, p. 83, fig. 100.
Hustedt, 1928, p. 707, fig. 403.
Lebour, 1930, p. 139, fig. 101.
*Chaetoceros hiemalis* Cleve, 1900.
*Chaetoceros pseudobreve* Pavillard, 1911, p. 26.

Cells united to form short chains. Valves often flat but sometimes with a central inflation. Bristles thin and often straight, arranged in the apical plane. Foramina elliptical, sometimes almost square, but may be very narrow. Valve mantle usually equal to the connective zone. Chromatophores: one large one in each cell, adpressed to the valve. Diameter of valve, polar axis 20–26$\mu$; pervalvar axis 14–20$\mu$.

Common in the Atlantic and Indian Oceans. Observed frequently around the coast of Africa.

Observed at Sts. 425, 428, 433, 439.

**Chaetoceros Ralfsi Cleve.**

Cleve, 1873, p. 10, pl. 3, fig. 15.
Karsten, 1906, p. 168, pl. 33, fig. 16.

Cells united to form chains, usually short, consisting of seldom more than six cells. Valves elliptical in outline. Valve surface weakly concave with slight median inflation. Bristles thin, emerging immediately from the angles of the cells. Those of the upper valve are arranged in an almost horizontal position, while those of the lower valve proceed downwards in an oblique manner towards the posterior end of the chain. The bristles upon the lower valve of a terminal cell are very much stouter than the others. They emerge from the angles of the valve and proceed outwards obliquely. At approximately two-thirds of the length, the bristles are bent and proceed in a direction almost parallel with the axis of the chain. These terminal bristles widen considerably at the place of bending but taper to a fine hair-like extremity, also they are armed with fine spines through the greater part of their length. They closely resemble the terminal bristles of *C. buceros* Karsten, and are somewhat tortuous. Foramina narrow, linear lanceolate. Chromatophore: one large plate.

Probably a neritic species, favouring a high salinity and warm water. It was observed frequently but never in great numbers along the east coast of Africa and at one station only in the Peru Current.

Observed at Sts. 425, 1356, 1358, 1359, 1584, 1586; WS 710.

### Section FURCELLATA

**Chaetoceros neglectum** Karsten.

Karsten, 1905, p. 119, pl. 16, fig. 5.
Mangin, 1915, p. 47, fig. 29.

Cells small, united to form chains, chains sometimes twisted. Cells in girdle view rectangular or suboctagonal, weakly siliceous. Valves flat at the centre, valve mantle narrow, sloping obliquely to the connective zone. Bristles very fine, emerging just inside the flattened portion of the valve surface and proceeding in a direction parallel with the axis of the chain to meet those of the neighbouring cell when they turn outwards immediately at right angles to the axis of the chain. Bristles smooth. Foramina rectangular. Chromatophore: one plate lying close to the girdle. Diameter of valve 10–15μ.

A small characteristic Antarctic diatom common on the western side of the Southern Ocean. It was observed, sometimes in great numbers, around the South Shetlands, South Georgia, the South Sandwich Group and again far south in the Weddell Sea and the Bellingshausen Sea. It is probably neritic and favours a low salinity.

Observed at Sts. 337, 338, 378, 379, 380, 382, 383, 434, 435, 436, 437, 438, 439, 475, 477, 478, 479, 481, 501, 506, 508, 510, 512, 513, 575, 576, 577, 578, 580; WS 100, 548, 549, 550, 551, 552A, 598.

**Chaetoceros filiferum** Karsten.

Karsten, 1907, p. 392, pl. 44, fig. 5.

Cells united to form short chains, four to twelve cells in a chain, cells rectangular in girdle view. Valves almost circular in outline, with a flat or slightly convex surface. Bristles emerging from the angles of the cells and crossing those of the neighbouring cells outside the girdle line. Bristles short, slightly curved, smooth. Foramina elongated, narrow. Chromatophores: two in each cell. Diameter of valve 20–24μ.

Probably an oceanic species, observed in small numbers in the Indian Ocean and off the coast of South Africa.

Observed at St. 425.

### Section BREVICATENATA

**Chaetoceros fragile Meunier.**

Meunier, 1910, p. 244, p. 27, figs. 27–29.
Lebour, 1930, p. 153, fig. 116.

Cells small, united in short irregular chains; usually four to eight cells in a chain, sometimes solitary. Cells in girdle view rectangular, valves slightly convex, oval in outline. Bristles arising directly from the corners of the cell. Bristles thin and usually short, often crossing those of the neighbouring cell outside the girdle line of the cells. Bristles of the two valves proceeding in opposite directions. Chromatophores: few cocciform bodies. Diameter of valve 8–12$\mu$; pervalvar axis 8–10$\mu$.

This very small species was met with but once. It occurred in small numbers off the coast of Natal. It was described first by Meunier from the Arctic.

Observed at St. 440.

**Chaetoceros pseudocrinitum Ostenfeld.**

Ostenfeld, 1901, p. 300, fig. 11.
Hustedt, 1930, p. 733, fig. 422.
Lebour, 1930, p. 154, fig. 118.

Cells united to form straight chains, in girdle view rectangular. Valves elliptical in outline, with flat central areas. Angles of the valves very slightly produced. The bristles are slightly divergent; they emerge from the poles of the cells and cross those of the neighbouring cell at the point of emergence and proceed at right angles to the axis of the chain. The bristles upon the lower valve of a terminal cell emerge and continue obliquely for about one-third of their length, and then turn gently in a direction almost parallel with the axis of the chain. Foramina linear-lanceolate. Chromatophore: one large plate.

A neritic species, widely spread throughout northern waters. It was observed at one station off South Africa, in small numbers only.

Observed at St. 432.

### Section DIVERSA

**Chaetoceros messanense Castracane.**

Castracane, 1875, p. 394, fig. 1.
Hustedt, 1930, p. 718, fig. 410.
*Chaetoceros furca* Cleve, 1897, p. 21.

Cells usually united to form short chains. Valves elliptical in outline; central area flat, poles produced to form stiff bristles, which cross with those of the neighbouring cells at the point of emergence. Valve mantle narrow, connective zone often deep. Three distinct types of bristles may be observed in the one chain. The majority of the bristles are thin and relatively short, but occasionally there occurs a pair of very stout, straight bristles, with widely bifurcate ends. The apices of the bifurcate extensions often show spiral markings, but these may be absent. The bristles upon the lower valve of a terminal cell are usually small and somewhat tortuous. Foramina somewhat hexagonal, merging to circular. Chromatophores: solitary, adpressed to the connective zone. Diameter of valve in the polar axis 12–46μ, mostly 36μ.

A tropical and subtropical oceanic species, frequent in the Indian and Pacific Oceans, seldom in the Atlantic. Very common off the coast of South Africa.

Observed at Sts. 425, 427, 428, 429, 433, 434, 435, 436, 437, 438, 439, 440, 1373; WS 630, 631, 641.

## Section Curviseta

**Chaetoceros debile** Cleve.

Cleve, 1894, 20, p. 13, pl. 1, fig. 2.
Gran, 1905, p. 92, fig. 117.
Hustedt, 1930, p. 740, fig. 428.
Lebour, 1930, p. 158, fig. 121.
*Chaetoceros vermiculus* Schütt, 1895, p. 39.

Cells united to form long curved and often twisted chains. Cells rectangular in girdle view, often square, oval in valve view. Valves flat or weakly convex. Bristles thin, emanating from the corners of the cell. Bristles curved and all bent towards the same side of the chain, giving to the chain the appearance that all the bristles emerge from one side of the cell only. Foramina, narrowly oblong. Chromatophores: one large plate. Diameter of valve in the polar axis 18–34μ.

A neritic species, common around all European coasts. Observed at one station only off the Falkland Islands.

Observed at St. WS 100.

## Section Socialia

**Chaetoceros sociale** Lauder.

Lauder, 1864, p. 77, pl. 8, fig. 1.
Gran, 1905, p. 96, fig. 123.
Hustedt, 1930, p. 751, fig. 435.
Lebour, 1930, p. 166, fig. 128.

Cells united in curved chains, held together in large rounded gelatinous colonies. Cells rectangular in girdle view, oval in valve view, valve surface flat. Bristles very fine, crossing those of the neighbouring cells outside the girdle line. Bristles of unequal length. Foramina, narrow, hexagonal. Chromatophore: one small plate. Diameter of valve in the polar axis 8–12μ.

A neritic species having a wide distribution from temperate to almost subpolar seas, common in north Atlantic waters. It was observed very frequently around South Georgia, off the Falkland Islands and throughout the Southern Ocean generally. It was noticed that the amount of mucilage required by the colonies increased as the species proceeded southward.

Observed at Sts. 378, 379, 380, 382, 479, 480, 482, 502, 505, 507–513; WS 100, 101, 580, 647, 700.

## Suborder SOLENIINEAE

## Family BACTERIASTRACEAE

### Subfamily *BACTERIASTROIDEAE*

1. Cells cylindrical, united in chains, each valve possessing usually four bristles, which, in the middle of the chain bifurcate, terminal bristles simple... ... ... ... *Bacteriastrum*

### Genus **Bacteriastrum** Shadbolt

Shadbolt, 1854

**Bacteriastrum comosum** Pavillard.

Pavillard, 1916, p. 29, pl. 1, fig. 3.
Hustedt, 1930, p. 622, fig. 361.

Cells united to form chains, six to fourteen cells in a chain. Cells elongated, cylindrical. Valve mantle deep, connective zone seldom as deep as the valve mantle. Valve surface furnished with a circlet of usually eight pendulous bristles which emerge at the margin of the valve almost in the axis of the chain and turn outwards obliquely and fuse with the bristles of the neighbouring cells. The fused portion proceeds at right angles to the axis of the chain for approximately one-third of the total length of the bristle and then bifurcates. The bifurcate ends are bent towards the posterior end of the chain and are slightly recurved. Foramina distinct. The bristles on the upper valve of the terminal cell at the anterior end of the chain are thick, and are not bifurcate; they are slightly pendulous and somewhat tortuous. The bristles on the lower valve of the terminal cell at the posterior end of the chain are thicker and longer than the others. They emerge at right angles to the axis of the chain in a direction parallel with the chain axis. These posterior bristles are somewhat tortuous, undulate, and bear spiral markings. The valve mantles of the anterior and posterior valves of terminal cells are sharply constricted close to the bristles. Valves hyaline. Chromatophores: several plate-like bodies. Diameter of valve 15–24$\mu$; pervalvar axis 46$\mu$.

This species has a localized tropical distribution. It has been reported from the Mediterranean, but is not frequent there. It was observed in considerable quantity off the east coast of Africa in equatorial waters, and favours a high salinity; it is probably a neritic species.

Observed at Sts. 1583, 1584, 1586.

**Bacteriastrum criophilum** Karsten.

Karsten, 1906, p. 170, pl. 33, fig. 22.

Cells united to form chains, four to eight cells in a chain. Cells elongated, cylindrical. Valve mantle very deep. Valve surface furnished with a circlet of usually six pendulous bristles. The bristles emerge slightly obliquely and at about one-third the total length bend towards the posterior end of the chain becoming almost parallel with the chain axis. The bristles do not furcate and are armed with small spines throughout the greater part of their length. The bristles of the terminal cells differ but slightly; those of the lower valve at the posterior end of the chain are longer and more pendulous, that is, they proceed in the direction of the chain axis for almost their entire length. The valve mantles of the anterior and posterior valves of terminal cells are sharply constricted close to the bristles. Foramina small, difficult to define. Chromatophores: numerous cocciform bodies. Diameter of valve 14–18μ; pervalvar axis 40–60μ.

A very common species around the coast of South Africa.

Observed at Sts. 435, 437, 438, 439.

**Bacteriastrum elongatum** Cleve.

Cleve, 1897 *a*, p. 19, pl. 1, fig. 19.
Karsten, 1905, p. 170, pl. 33, fig. 23.
Ikari, 1927, p. 425, fig. 5 *a*.
Hustedt, 1930, p. 617, fig. 357.
Lebour, 1930, p. 85, pl. 3, fig. 2 *a*.

Cells united to form chains. Cells elongated, cylindrical. Valve mantle deep, connective zone usually the same depth as the valve mantle. Valve surface furnished with seven to nine bristles, emerging obliquely and fusing, for a very short distance only, with the bristles of the neighbouring cells. The bristles then bifurcate and are arranged almost in the plane parallel with the chain axis. Bristles rather short and straight. Bristles of terminal cell alike at both ends of the chain. The terminal bristles are thicker; they emerge from the valves slightly obliquely, and curve gently towards the chain axis, until parallel with it. The bristles of the terminal cells point in opposite directions and are furnished with small spiral markings. Foramina small, somewhat indistinct. Chromatophores: several small rounded bodies. Diameter of valve 12–24μ; pervalvar axis up to 60μ.

This species was widely spread through temperate and subtropical seas. It was observed very frequently around the coast of South Africa sometimes in great numbers.

Observed at Sts. 425, 427, 428, 432, 434, 435, 436, 437, 438, 439, 440.

**Bacteriastrum delicatulum** Cleve.

Cleve, 1897 *b*, p. 298, fig. 15.
Gran, 1905, p. 58, fig. 72.
Hustedt, 1930, p. 612, fig. 353.
Ikari, 1927, p. 424.

Cells united to form straight chains. Cells elongated, cylindrical. Each valve furnished with a circlet of seven to ten bristles which emerge obliquely and fuse with those of the neighbouring cells. The fused portion, equal to about half the total length of the bristle, proceeds outwards at right angles to the chain axis, and then bifurcates. The bifurcate portions are bent only very slightly. The bristles attached to the exterior valves of the terminal cells are thicker than the others; they are alike at both ends of the chain and bent back towards the chain axis, somewhat irregularly, and armed with very small spines which are arranged spirally. Foramina sometimes rather large. Chromatophores: numerous cocciform bodies. Diameter of valve 10–30μ; pervalvar axis 20–40μ.

An oceanic species widely distributed in northern waters. It was observed occasionally around the coast of South Africa, and in the Peru Current.

Observed at Sts. 425, 427; WS 621, 709.

**Bacteriastrum hyalinum var. princeps** (Castracane) Ikari.

Ikari, 1927, p. 423, fig. 3.
Hustedt, 1930, p. 615, fig. 355.
*Bacteriastrum varians*, var. *princeps* Castracane, 1886, p. 84, pl. 14, fig. 2.

Cells rectangular, cylindrical, united to form short chains. Valve surface furnished with a circlet of usually sixteen to twenty-four bristles, which emerge and fuse with those of the neighbouring cells close to the valve margin. At a distance of about one-third of the total length of the bristles, bifurcation takes place. The bifurcate portions are spirally twisted in the second half of their length, and usually lie in the same plane as the chain axis. The bristles attached to the exterior valves of the terminal cells are usually the same thickness as the others; they are alike at both ends of the chain, and are directed obliquely towards the chain axis, but only slightly so, and are not pendulous. Foramina obscure, very narrow. Chromatophores: numerous cocciform bodies. Diameter of valve 25–50μ; pervalvar axis 44μ.

A neritic species widely spread through tropical and subtropical seas. It was very common around South Africa.

Observed at Sts. 425, 427, 428, 435, 438, 439; WS 709, 710.

**Bacteriastrum varians** Lauder.

Lauder, 1864, p. 8, pl. 3, figs. 1–6.
Karsten, 1906, p. 170, pl. 34, fig. 1.

Cells rectangular, cylindrical, united to form short chains. Valve surface furnished with a circlet of usually six to ten bristles, which emerge and fuse with those of the neighbouring cells close to the valve margin. The bristles remain fused for nearly half their length and then furcate. The furcate portions lie in the valvar plane. The bristles attached to the exterior valves of the terminal cells are usually thicker than the others; they bear spiral markings and are alike at both ends of the chain. They proceed outwards at right angles to the chain axis, and their extremities are slightly curved and bent slightly downwards towards the chain. Chromatophores: numerous cocciform bodies. Diameter of valve 20–30μ; pervalvar axis 24μ.

An oceanic species, common in tropical waters. It was frequently observed around the coast of South Africa.

Observed at Sts. 425, 427, 428, 433; WS 706.

## Family RHIZOSOLENIACEAE

### Subfamily *RHIZOSOLENIOIDEAE*

1. Cells tubular, valves conical, spine eccentric, sometimes marginal ... ... *Rhizosolenia*
2. Cells tubular, valves flat, with marginal spur, connective zone annular ... ... *Guinardia*

### Genus **Rhizosolenia** Ehrenberg emend. Brightwell

Brightwell, 1858

non *Rhizosolenia* Ehrenberg, 1843

The name *Rhizosolenia* was used first by Ehrenberg (1843, p. 402). One species was described, *R. americana*, p. 422. Brightwell (1858, p. 93) gave a synopsis of the then known species, and said of the figures of the type provided by Ehrenberg in *Mikrogeologie* (1854), "most of them certainly not belonging to this genus". Brightwell continued to give a description of the genus *Rhizosolenia*, and described four new species, the first being *Rhizosolenia styliformis*. Ehrenberg's type, namely *Rhizosolenia americana*, was subsequently transferred to the genus *Pyxilla* by Grunow in Van Heurck's *Synopsis*, pl. 83*b* (1880–85).

The legal position is that the genus *Pyxilla* should be referred to *Rhizosolenia*, and a new generic name should be chosen for those forms which are known as *Rhizosolenia*. As this step would cause further chaos, and serve no useful purpose, I propose to use the name *Rhizosolenia* in the sense that Brightwell used it, and to consider *Rhizosolenia styliformis* Brightwell as the type of the genus, until such time as *Rhizosolenia* shall be legally conserved.

This genus is truly planktonic, and with one or two exceptions wholly marine. Its members exhibit the fullest development of the "solenoid" or tubular structure, which is carried out by a complete system of intercalary scale-like segments in the connective zone. The division of the genus depends upon the type and position of the scales, whether they are small and squamose or large and annular, whether they are arranged in dorsiventral or lateral lines. The valve portion is usually conical, eccentric and terminated by a spine. I refer to the Rhizosoleniaceae as the "mucronate solenoids". The spine may be solid, or usually with a hollow base, which is connected with the plasma of the cell by means of a fine tube opening into the apex of the valve. In some species the mucro is furnished with small wings, which are often continued down to the apex of the valve proper. These wings may be lateral or dorsiventral. The valves of the cell and sometimes portions of the connective zone near the valve bear lines or depressions which correspond to the spine of the sister cell. This is caused by the adpression which takes place within the mother cell while the valves are very young and plastic. The connective zone is usually finely punctate, but the entire cell, in most cases, is so weakly siliceous as to be destroyed if treated with mineral acids. The pervalvar axis of the cell is anything from 4 to 100 times as long as the diameter.

The chromatophores are usually numerous and cocciform, arranged around the cell wall and upon lines of plasma which radiate from the nucleus. Auxospores and resting spores have been observed; the former occur in some species as a lateral projection at right angles to the pervalvar axis of the parent cell. Some species, particularly those of the *R. styliformis* group, are liable to infection by parasites. The alga *Richelia intercellularis* was observed, but not frequently, within the cells of *R. styliformis* from tropical stations upon the Indian Ocean side of Africa. Several species exhibit what I describe as polyphasic tendencies, that is several species are found possessing more than one set of morphological characters, and in some specimens both sets of characters are present, indicating specific unity of the variants. The chief of these are *R. alata* and *R. hebetata*. All of the so-called varieties and forms of these species I have reduced to synonyms and have described them as phases of a plastic species system.

**Rhizosolenia alata** Brightwell.

Brightwell, 1858, p. 96, pl. 5, fig. 8.
Gran, 1905, p. 56, fig. 68.
Hustedt, 1929, p. 600, fig. 344.
Lebour, 1930, p. 88, fig. 58.

Cells tubular, elongated, cylindrical, straight. Valves shortly conical, attenuated to produce an eccentric process. Process truncate or slightly rounded, almost parallel with the main axis of the cell or very slightly incurved. Valve furnished at the base with a faint depression which corresponds to the apex of the neighbouring cell, and fits into it when in chain formation. Terminal spine absent. The connective zone is composed of two rows of dorsi-ventral scale-like intercalary markings, which appear as a zigzag line in lateral view. Scales rhombic, furnished with very fine striation. Chromatophores: numerous cocciform bodies, nucleus almost central. Diameter of cell 10–20μ; pervalvar axis up to 700μ.

An oceanic species having a wide distribution throughout temperate and subtropical seas. It was one of the most common diatoms observed in the 'Discovery' material, and was noticed in practically all samples except those from off the Brazil coast; sometimes it occurred in very great numbers.

Observed at Sts. 263, 300–305, 335, 336, 337, 338, 339, 340, 365, 368, 369, 378, 379, 380–388, 425, 427, 428, 431–436, 438, 439, 440, 450, 460, 475, 478, 479, 505–508; 511, 513, 575–578, 580, 615, 659, 666, 670, 671, 675, 681, 684, 687, 690, 1356, 1358, 1359, 1362, 1369, 1373, 1584, 1586, 1589; WS 469, 540, 541, 545, 547, 549, 550, 551, 552A, 598, 703, 705–712, 714.

"gracillima" phase.

*Rhizosolenia alata*, forma *gracillima* (Cleve) Grunow.
Grunow, in Van Heurck, 1880–85, pl. 79, fig. 8.
Hustedt, 1929, p. 601, fig. 345.
Lebour, 1930, p. 90, fig. 59.

Very similar to the type structurally, but considerably thinner. The valve is somewhat less conical than the type, but a little more produced. Diameter of valve 4–7μ; pervalvar axis up to 500μ.

A neritic species, but also found under oceanic conditions. Very widespread, often associated with the type, but more common in subtropical waters. A very weakly siliceous species. It was common around the Cape of Good Hope, particularly on the east side, extending northwards of Madagascar along the Somaliland coast, often in great numbers. It was common also under sub-Antarctic conditions off Bouvet Island and in the Weddell Sea in summer, also around South Georgia and between the Falkland Islands and Port Desire on the mainland of South America.

Observed at Sts. 294, 335, 427, 428, 431, 432, 437, 440, 461, 477, 542–4, 552, 553, 574–576, 578, 580, 666, 671, 675, 1376, 1584, 1586; WS 100, 101, 106, 107, 469, 474, 481, 600, 629, 630, 631, 666, 710, 714, 715.

"indica" phase.

*Rhizosolenia alata*, forma *indica* (Peragallo) Hustedt.
Ostenfeld, 1901, p. 160 (as var.).
Hustedt, 1929, p. 602, fig. 346.
*Rhizosolenia indica* Peragallo, 1892, p. 116.
*Rhizosolenia alata*, var. *indica* (Peragallo) Ostenfeld et Schmidt.

Cells structurally similar to the type, but possessing a much greater diameter. Valve broadly conical, narrowing suddenly to produce the short and relatively thin process. Process more centric than that of the type, but often set in an oblique position. The markings upon the connective zone may be composed of two rows of dorsiventral, scale-like bands or numerous imbricated scales. Scales striate. Diameter of cell 20–60$\mu$.

An oceanic species, more common in tropical and subtropical waters than in cold water. It was observed at two stations only in the Peru Current.

Observed at Sts. WS 705, 706.

"inermis" phase.

*Rhizosolenia alata*, forma *inermis* (Castracane) Hustedt.
Hustedt, 1929, p. 602, fig. 348
*Rhizosolenia inermis* Castracane, 1886, p. 71, pl. 24, figs. 7, 8, 10.
*Rhizosolenia obtusa* Hensen, 1887, p. 86, pl. 5, fig. 41.

Cells structurally similar to the type, but possessing valves with sharply truncated apices. Apices straight or only very slightly curved, and bearing a small but distinct cleft. Diameter of cell 10–20$\mu$.

An oceanic species having a wide distribution in all northern waters. It was observed frequently around the coast of Africa, Cape Horn, South Georgia, and far south in the Weddell Sea.

Observed at Sts. 260, 262, 381, 383, 384, 440, 460, 475, 478, 480, 482, 501, 508–510, 512, 513, 1358, 1359; WS 545, 548, 550–552A.

**Rhizosolenia annulata** Karsten.

Karsten, 1907, p. 378, pl. 41, fig. 4.

Cells large, usually solitary, straight. Valves shortly conical, very oblique, ventral side gently curved. Valve terminated with a short sharp spine, hollow at the base. Spine not erect, but directed outwards over the dorsal margin of the cell. Connective zone composed of numerous regular annular segments arranged in two dorsiventral lines, edges of segments parallel. Imbrications clear, undulated close to the valve margin. The cell wall is covered with a very fine punctation, arranged in quincunx. Chromatophores: numerous rather large rounded bodies. Diameter of cell 90–110μ.

A large tropical species, probably oceanic. It was observed in small numbers off the Brazil coast.

Observed at Sts. 719, 721, 722.

**Rhizosolenia Bergonii** H. Peragallo.

Peragallo H., 1892, vol. 1, p. 110, pl. 3, fig. 5 (pl. 15, fig. 5).
Gran, 1905, p. 51, fig. 60.
Hustedt, 1929, p. 575, fig. 327.
Lebour, 1930, p. 102, fig. 74 *b*.
*Rhizosolenia amputata* Ostenfeld, 1902, p. 227, fig. 4.

Cells cylindrical, straight, furnished with long conical valves. Valves produced, slightly attenuate, terminated with a short, straight spine. Spine truncate, bearing a small central canal. This canal is slightly inflated at its base, and cup-shaped at the apex of the spine. The connective zone is furnished with four or five rows of scale-like intercalary bands. The dorsal margin of the scales is curved, or bow-shaped. The whole cell is minutely punctate, but the valves are a little more strongly marked than the connective zone. Chromatophores: numerous cocciform bodies. Diameter of cells 80–100μ; pervalvar axis 550μ.

An oceanic species having a wide distribution in tropical and subtropical seas. It was observed in the equatorial regions of the Atlantic Ocean, off the west coast of Africa.

Observed at Sts. 293, 675, 684, 687.

**Rhizosolenia bidens** Karsten.

Karsten, 1905, p. 98, pl. 9, fig. 13.

Cells cylindrical, usually solitary. Valves regularly conical, terminated with a large bifurcate spine. Connective zone composed of two dorsiventral lines of intercalary scale-like markings, somewhat similar to those of *R. styliformis*. Chromatophores: numerous cocciform bodies. Diameter of cell 40–80μ.

The illustration provided by Karsten gives little idea of the size and strength of the bifurcate spine so characteristic of this species. It is more adequately illustrated by Castracane (1886) pl. 24, fig. 14, as *Rhizosolenia* sp.

An oceanic and cold-water species. It was common around South Georgia, the South Shetlands and the South Sandwich Group.

Observed at Sts. 368, 369, 378–381, 383, 425, 475, 479, 507; WS 542, 543.

**Rhizosolenia calcar-avis** Schultze. (Pl. XI, fig. 14.)

Schultze, 1858, p. 339, pl. 13, figs. 5–8.
Karsten, 1907, p. 380, pl. 41, fig. 5.

Gran, 1905, p. 54, fig. 66.
Hustedt, 1929, p. 592, fig. 339.
Lebour, 1930, p. 99, fig. 72.

Cells cylindrical, tubular, with regularly conical valves, terminated with a curved spine. Spine slightly eccentric, producing a faint depression on the neighbouring cell at the place of attachment. Connective zone furnished with lines of intercalary scale-like markings. In small specimens the scales are arranged in two dorsiventral lines, but in the larger ones seven to ten lines may be present, giving the zone a squamose appearance. The connective zone is very minutely punctate. The whole cell is weakly siliceous, and the markings in the zonal aspect are seen with great difficulty even when the specimens are examined mounted dry. Chromatophores: a few rounded bodies. Diameter of cells 20–80μ; pervalvar axis 700μ.

An oceanic species common in tropical seas, very common in the Mediterranean, but seldom observed in the North Sea. It was observed frequently around the coast of Africa, particularly upon the eastern side, and also in the material from the Pacific taken in the Peru Current.

Observed at Sts. 425, 427, 428, 437, 439, 1373; WS 709, 710.

**Rhizosolenia Castracani** H. Peragallo.

Peragallo, H., 1888, p. 83, pl. 6, fig. 42.
Karsten, 1906, p. 164, pl. 30, fig. 144.
Hustedt, 1929, p. 607, fig. 351.
Lebour, 1930, p. 103, fig. 75 *a*.

Cells large, cylindrical, furnished with small conical valves. Apex of the valve short, oblique, terminated with a very small spine, basis of spine often inflated. Connective zone furnished with numerous pervalvar lines of intercalary scale-like markings. Scales somewhat irregular as they approach the valve. The cell wall is rather thick and strong, but the imbricate markings are seen with difficulty. The connective zone is punctate. Chromatophores: several rounded bodies. Diameter of cells 150–180μ; pervalvar axis 600–750μ.

An oceanic species common in temperate waters. It is found frequently in the Atlantic Ocean and in the Mediterranean. It was observed off the coast of South Africa and off the Cape Verde Islands.

Observed at Sts. 434, 438, 684.

**Rhizosolenia Chunii** Karsten.

Karsten, 1905, p. 99, pl. 11, fig. 5.

Cells cylindrical, forming short chains, sometimes slightly flattened laterally. Cells straight, almost rectangular. Valves slightly convex, but sometimes almost flat, furnished with a short sharp spine placed in a marginal position. Spines hollow at base, difficult to see, except those which project beyond the terminal valves. Connective zone composed of two lateral lines of intercalary scale-like markings in zigzag rows. Scales finely striate. Chromatophores: numerous cocciform bodies. Diameter of cell 26–32μ; pervalvar axis 80μ.

A characteristic Antarctic species. It was observed in small numbers at most stations in the Bellingshausen Sea and off Cape Horn.

Observed at Sts. 574, 575, 577, 578, 580; WS 593, 594.

### Rhizosolenia crassa Schimper ex Karsten.

Karsten, 1905, p. 99, pl. 11, fig. 6.

Cells large, often united to form short chains, cylindrical, but often flattened laterally. Valves shortly conical, slightly oblique, terminated by a long eccentric spine. Spine bulbous and hollow at the base, tapering to a fine point. Connective zone composed of usually two dorsiventral lines of intercalary scale-like markings. Imbrications clear, wavy, sometimes squamose. Chromatophores: numerous cocciform bodies, often conglomerated to form a transapical band through the cell, surrounding the nucleus. Diameter of cell 160–220μ; pervalvar axis 400–900μ.

Probably a neritic species. Typically Antarctic. It was observed sometimes in quantities around South Georgia, the South Sandwich Group and Bouvet Island.

Observed at Sts. 334, 335, 337–440, 461; WS 469, 542.

### Rhizosolenia curvata Zacharias.

Zacharias, 1905, p. 121
*Rhizosolenia curva* Karsten, 1905, p. 97, pl. 11, fig. 2.

Cells cylindrical usually solitary, but may be in short chains, slightly curved, sometimes crescentic. Valves deeply conical, regular, terminated with a long sharp spine. Spine slender, with hollow base. Connective zone composed of two lines of dorsiventral intercalary scale-like markings, similar to *R. styliformis*. Cells weakly siliceous, imbrications seen only with difficulty. Scales furnished with very fine punctation arranged in quincunx. Chromatophores: numerous cocciform bodies, often arranged around the cell wall, nucleus usually central. Diameter of cells 20–60μ.

A typical sub-Antarctic species widely spread throughout the Southern Ocean, often in great numbers. It was observed frequently around South Georgia and in the Drake Straits. It was observed also to the south-east of the Cape of Good Hope, in the latitude of 42° S on the 40th E meridian.

Karsten's *Rhizosolenia curva* was published in 1905, in the same year as Zacharias's name *Rhizosolenia curvata*, and it was a matter of great difficulty to establish the claim of the latter to priority. Hart (1935, p. 160) used Karsten's combination to describe this species, but during a critical study of the literature later, discovered that Zacharias's publication appeared first, and that Karsten admitted Zacharias's claim and adopted his name in 1907 (Deutschen Tiefsee Exped. 1907, p. 164). I am indebted to Dr Hart for furnishing me with these particulars.

Observed at Sts. 387, 388, 433, 501, 659, 666, 670, 671, 679, 1369.

**Rhizosolenia delicatula** Cleve.

Cleve, 1900 *b*, p. 28, fig. 11.
Gran, 1905, p. 48, fig. 52.
Karsten, 1906, p. 163, pl. 29, fig. 8.
Hustedt, 1929, p. 577, fig. 328.
Lebour, 1930, p. 91, fig. 63.

Cells cylindrical, united to form short straight chains. Valves flat, but slightly rounded at the margins, furnished with a short marginal spine which fits into a small depression on the margin of the valve of the neighbouring cell. Connective zone furnished with annular segments seen only with great difficulty. Chromatophores: few large plates, rounded or stellate. Diameter of cells 16–22μ; pervalvar axis 60μ.

A neritic species, common around the southern coasts of Europe, and the temperate zone of the Atlantic Ocean. It was observed at one station in the Pacific material from the Peru Current. The distribution of this species is not yet fully known.

Observed at St. WS 593.

**Rhizosolenia fragilissima** Bergon.

Bergon, 1903, p. 49, pl. 1, figs. 9, 10.
Hustedt, 1929, p. 571, fig. 324.
*Rhizosolenia delicatula* Gran, 1902, p. 172.
*Rhizosolenia delicatula* Ostenfeld, 1903, p. 568, fig. 123.

Cells shortly cylindrical, united to form short, loose, but straight chains. Valves weakly convex, furnished with a short spine placed almost in the centre, which fits into a small depression in the neighbouring cell. In small specimens the valves are rounded and the spine appears to be eccentric. Connective zone composed of numerous annular segments which, because of the weakly siliceous nature of the cell, are seen with great difficulty. Chromatophores: numerous small plates. Diameter of cells 20–40μ; pervalvar axis 50μ.

A neritic species common around the coasts of Europe. It was observed, sometimes in considerable quantities, around the south coast of Africa.

Observed at Sts. 425, 427, 428, 433.

**Rhizosolenia hebetata** Bailey.

Bailey, 1856, pl. 1, figs. 18, 19.

"semispina" phase.

*Rhizosolenia hebetata* Bailey, forma *semispina* (Hensen) Gran, 1905, p. 55, fig. 67 *b*.
*Rhizosolenia semispina* Hensen, 1887, p. 84, pl. 5, fig. 39.

Cells cylindrical, valves conical, attenuate, armed with a long spine. Spine straight or slightly curved, possessing an internal cavity. Connective zone furnished with two dorsiventral lines of intercalary scale-like markings, scales somewhat rhombic, but have the appearance of a zigzag line when the cell presents a lateral aspect. The upper portion of the connective zone is often clearly marked with a depression corresponding to the spine of the neighbouring cell. The cell is very weakly siliceous and the striation upon the connective zone, which is extremely fine, is seen only with great difficulty. Chromatophores: numerous cocciform bodies. Diameter of cell 5–40μ; pervalvar axis 400–750μ.

One of the most common forms of *Rhizosolenia* observed in the Discovery material. It was observed in all types of water, but more frequently in the waters of the tropical and subtropical zones. It occurred around the coast of Africa, particularly on the west side, but was not frequent around the Cape of Good Hope, and was absent from the material obtained from the eastern side, in the Indian Ocean. It occurred frequently at many stations around South Georgia, the South Sandwich Group, Cape Horn, and far south into the Weddell and Bellingshausen Seas. It was common at many stations in the Peru current and sometimes found in great quantities. Great variation was observed in this species, particularly with regard to dimensions. Many of the specimens from the more southerly stations were very thin, while those from the Pacific side of South America were strong and possessed a much greater diameter.

Observed at Sts. 289, 292–294, 301, 303–305, 365, 368, 369, 381, 383, 384, 449–451, 460, 480–482, 501–506, 508–511, 659, 661, 722; WS 107, 540–543, 545, 547–552A, 598, 641, 643, 700, 701, 703–708, 710, 714–716.

### Rhizosolenia imbricata Brightwell.

Brightwell, 1858, p. 95, pl. 5, fig. 6.
Karsten, 1905, p. 98, pl. 11, fig. 3.
Hustedt, 1929, p. 580, fig. 331.
*Rhizosolenia striata* Greville, 1866 *a*, p. 234.

Cells large, cylindrical, slightly flattened laterally, furnished with shortly conical, strongly eccentric valves, having a strongly oblique ventral side. Valve furnished with a strong marginal spine which appears as a continuation of the dorsal side of the cell, spine straight. Cells often united to form short chains. Connective zone furnished with two lateral lines of intercalary scale-like markings. The markings are regular, with parallel sides, which give the appearance of annular segments with oblique ends. The imbricate scales of the connective zone are strongly marked with lines of areolation arranged obliquely, converging upon a line which occupies a median position on the connective zone, arranged laterally in the transapical plane. Chromatophores: several small rounded bodies. Diameter of cell 80–100μ; pervalvar axis 400–600μ.

An oceanic species having a distribution in tropical and subtropical seas, seldom found in north European waters, but has been observed in the Mediterranean. It was observed at one station only to the south-east of the Cape of Good Hope.

Observed at St. 443.

### Rhizosolenia polydactyla Castracane.

Castracane, 1886, p. 71.

Cells cylindrical, often slightly flattened laterally. Valves shortly conical, eccentric, oblique, ventral surface slightly curved. Valves terminated by a short, sharp spine, hollow at the base, and furnished with well-developed basal wings, which envelop the apex of the valve; wings rounded. Valves bearing depressions which correspond to the spines of sister cells. Connective zone composed of two lines of dorsiventral intercalary scale-like markings. Scales very narrow. Chromatophores: numerous rounded bodies. Diameter of cell, 100–160μ.

An oceanic species, usually regarded as a warm-water form, found frequently in the Mediterranean. It was observed frequently and sometimes in considerable quantities, in the Drake Strait, particularly around Cape Horn. It occurred far south in the Bellingshausen Sea, but not so plentifully as in the Drake Strait. At one station it was observed under tropical conditions, namely St. 1584, off the coast of Somaliland.

Observed at Sts. 385, 386, 387, 388, 560, 575, 578, 580, 1584; WS 469, 709, 710.

**Rhizosolenia rhombus** Karsten.

Karsten, 1905, p. 97, pl. 10, fig. 6 *a–c*.

Cells large, usually solitary, but sometimes in short chains. Cells cylindrical, slightly flattened laterally, almost rhombic in outline. Valves shortly conical, oblique, terminated with a short but stout spine. Spine not bulbous, hollow at the base, penetrating the valve. Spine furnished with thin wing-like projections, usually present on both sides of the spine, but more strongly developed upon the ventral side. Connective zone composed of two lines of dorsiventral intercalary scale-like markings. Scales narrow. Imbrications usually clear, but seldom parallel. Scales furnished with a fine punctation, usually arranged in quincunx. Chromatophores: numerous cocciform bodies, usually arranged in lines radiating from an eccentric nucleus. Diameter of cells 100–180μ; pervalvar axis 400–500μ.

Probably a neritic species and typical of the sub-Antarctic zone. It was observed, often in considerable numbers, at a number of stations around South Georgia.

Observed at Sts. 334, 335, 339, 384, 461, 478, 479, 508.

**Rhizosolenia robusta** Norman ex Pritchard. (Pl. XI, fig. 13.)

Norman, in Pritchard, 1861, p. 866, pl. 8, fig. 42.
Gran, 1905, p. 50, fig. 57.
Karsten, 1906, p. 163, pl. 29, fig. 10.
Hustedt, 1929, p. 578, fig. 330.
Lebour, 1930, p. 94, fig. 68.
*Rhizosolenia sigma* Schütt, 1893, p. 22, fig. 12.

Cells usually solitary, but sometimes in short chains. Cells cylindrical in connective zone, often flattened laterally, possessing large and deeply conical valves. Cells sometimes slightly sigmoid or sublunate. Valves slightly curved and terminated by a small sharp spine. Connective zone composed of numerous annular segments; segments not complete but form discontinuous intercalary bands, with parallel edges. Connective zone rather strongly siliceous and covered with a minute punctation arranged in quincunx. Valves furnished with a number of lines which proceed from the valve margin toward the apex. Chromatophores: numerous cocciform bodies arranged around the cell wall and in lines which radiate from the nucleus. Diameter of cell 100–200μ; pervalvar axis up to 1 mm.

An oceanic species, widespread in tropical and subtropical waters, frequent in the Mediterranean, but seldom in the northern waters of Europe and the North Atlantic. It was observed but seldom in great numbers, around the Cape of Good Hope on the eastern side, off the coast of Natal, and on the east coast of Africa, off Madagascar to the south-west and again north of that island off the coast of Kenya and Somaliland.

Observed at Sts. 425, 428, 433, 435, 440, 1572, 1575, 1584, 1586; WS 700, 701, 703, 704, 706, 709.

**Rhizosolenia setigera Brightwell.**

Brightwell, 1858, p. 95, pl. 5, fig. 7.
Hustedt, 1929, p. 588, fig. 336.
Lebour, 1930, p. 98, fig. 70.
*Rhizosolenia Japonica* Castracane, 1886, p. 72, pl. 23, fig. 7.
*Rhizosolenia Hensenii* Schütt, 1900, p. 510, pl. 12, figs. 25–27.

Cells cylindrical, tubular, straight, usually solitary. Valves deeply conical, regular, furnished with a very long terminal spine. Spine straight, or only very slightly bent. Connective zone composed of two pervalvar lines of intercalary plates. Imbricate markings seen with difficulty, having the appearance of a zigzag line in lateral aspect. Chromatophores: numerous cocciform bodies. Diameter of cell 10–20μ; length of spine 60–120μ.

A neritic species, which favours cold waters. It is common around the coasts of most European countries, particularly those with an Atlantic seaboard. It was observed in small quantities at one station only in the Atlantic Ocean in latitude 20° S on the 30th W meridian.

Observed at St. 681.

**Rhizosolenia Shrubsolii Cleve.**

Cleve, 1881, p. 26.
Gran, 1905, p. 52, fig. 63.
Lebour, 1930, p. 96, fig. 69.

Cells cylindrical, slightly flattened laterally, usually solitary, but sometimes united to form short chains. Valves shortly conical, strongly eccentric, oblique, but curved on the ventral side and furnished with a short spine in line with the dorsal margin of the cell. Spine hollow throughout almost all its length and furnished with an alate base. The valve often bears a small depression which corresponds to the spine of the neighbouring cell. Connective zone composed of two pervalvar lines of intercalary scale-like markings transapically opposed. The imbrications have the appearance of a zigzag line when the cell presents the ventral aspect. The cell is covered with a fine striation, which is usually finer on the valve than on the connective zone and is often very weakly siliceous. Chromatophores: numerous cocciform bodies arranged around the cell wall and in lines radiating from the central nucleus. Diameter of cell 20–44μ.

An oceanic species having a wide distribution in European waters, usually considered as a northern form. It was observed, however, sometimes in considerable quantities, off the west coast of Africa, off the coast of Natal and to the south of Madagascar, under tropical conditions, in the Drake Strait immediately to the north of the South Shetlands, and off Bouvet Island under sub-Antarctic conditions. It was observed also in the Pacific material from the Peru Current.

Observed at Sts. 275, 300–304, 383, 386, 460, 684, 1373, 1570; WS 647, 700, 703, 704.

**Rhizosolenia simplex** Karsten.

Karsten, 1905, p. 95, pl. 10, fig. 1.

Cells small, cylindrical, symmetrical about the pervalvar axis. Cells straight, valves deeply conical, terminated by a slender tapering spine. Spine hollow at the base. Connective zone composed of numerous small squamose intercalary scale-like markings. Imbrications seen with difficulty, owing to the weakly siliceous nature of the cell. Chromatophores: numerous cocciform bodies, usually arranged along the cell wall in association with the eccentric nucleus. Diameter of cell, 10–26$\mu$; pervalvar axis 200–400$\mu$.

An oceanic species characteristic of the sub-Antarctic zone, widespread throughout the Southern Ocean. It occurred frequently to the south-west of the Cape of Good Hope, and from the South Sandwich Group to South Georgia and Cape Horn; it was not found in truly Antarctic waters.

Observed at Sts. 263, 264, 365, 378, 382, 383, 425, 427, 428, 433, 435, 436, 438, 439, 440, 478, 479, 510, 659, 1369; WS 630, 706.

**Rhizosolenia Stolterfothii** H. Peragallo. (Pl. XI, figs. 7, 8.)

Peragallo H., 1888, p. 82, pl. 6, fig. 44.
Gran, 1905, p. 49, fig. 55.
Karsten, 1906, p. 162, pl. 29, fig. 8.
Hustedt, 1929, p. 578, fig. 329.
Lebour, 1930, p. 93, fig. 66.
*Eucampia striata* Stolterfoth, 1879, p. 835.
*Pyxilla Stephanos* Hensen, 1887, p. 88, pl. 5, fig. 36.

Cells cylindrical, short, united to form curved chains. Valves flattened, slightly rounded at the edges and furnished with a short sharp marginal spine, which fits into a depression upon the valve of the neighbouring cell. Connective zone composed of numerous annular segments, segments discontinuous. The imbrications are seen with difficulty owing to the weakly siliceous nature of the cell. Cell wall without visible structure. Chromatophores: numerous cocciform bodies, nucleus often close to the ventral wall of the cell. Diameter of cell 20–50$\mu$.

A neritic species, widely spread throughout northern seas, common in the Mediterranean. It was observed off the coast of Natal, but only in small numbers.

Observed at Sts. 433, 434, 435, 439, 1373.

**Rhizosolenia styliformis** Brightwell. (Pl. XI, figs. 15–17.)

Brightwell, 1858, p. 95, pl. 5, fig. 5.
Karsten, 1905, p. 96, pl. 10, fig. 5.
Hustedt, 1928, p. 584, fig. 333.
Heiden et Kolbe, 1928, p. 516.
Lebour, 1930, p. 98, fig. 71.

Cells cylindrical, straight, solitary. Valves rather deeply conical, oblique, ventral margin almost straight, furnished with an apical spine, which is arranged in a straight line with the dorsal margin of the valve. The spine is furnished with a cavity which penetrates the valve, and wing-like projections at the base. The valve bears a depression which corresponds to the spine of the sister cell. Connective zone composed of two dorsiventral lines of intercalary scale-like markings which have the appearance of interlocking fingers when the cell presents a lateral aspect, and not a zigzag of straight lines as in the ventral aspect of *R. Shrubsolii*. Cell wall usually strongly siliceous and imbrications clear. Connective zone covered with a fine punctation arranged in quincunx. Chromatophores: numerous cocciform bodies, arranged around the cell wall and in lines radiating from the central nucleus. Diameter of cells 40–100μ.

An oceanic species, widely spread throughout all parts of the globe, perhaps the most common species of *Rhizosolenia*. It was observed frequently and sometimes in considerable quantities around the coast of South Africa, particularly on the east side and northwards by Madagascar and the Somaliland coast, under tropical conditions. It was very common around South Georgia, the South Sandwich Group, Bouvet Island, and in the Drake Strait, under sub-Antarctic conditions. It was not observed, however, far south in the Bellingshausen or Weddell Seas.

Observed at Sts. 334–339, 385–388, 427, 431, 432, 433, 438, 461, 475, 477–479, 482, 512, 661, 663, 681, 1356, 1358, 1359, 1373, 1570, 1572, 1574, 1581, 1584, 1586, 1589; WS 100, 104, 469, 474, 551, 569, 601, 645, 700, 701, 703, 704, 709, 710, 711; MS 86; RS 9.

**Rhizosolenia truncata** Karsten.

Karsten, 1905, p. 97, pl. 10, fig. 3 *a*.
Van Heurck, 1909, p. 28, pl. 4, fig. 73.

Cells small, cylindrical, united to form short chains, but sometimes solitary. The valves may be dissimilar, the one shortly conical, with its apex in an oblique position, the other shortly conical, with its apex drawn out to form a long slender erect process. Spines absent. The exterior valves of the terminal cells produce the long slender process. The cells are very weakly siliceous and the imbrications upon the connective zone are seen with great difficulty. Chromatophores: numerous cocciform bodies; nucleus small, usually eccentric. Diameter of cells 10–14μ; pervalvar axis 120μ.

An oceanic species, probably truly Antarctic. It was observed in small numbers only in the Bellingshausen Sea.

Observed at Sts. 461, 580.

### Genus Guinardia H. Peragallo

Peragallo, H., 1892

The genus *Guinardia* is included in the family Rhizosoleniaceae on account of the small rudimentary spine which is placed in a marginal position upon the valve surface. The cells are very weakly siliceous and the connective zone is composed of numerous narrow intercalary bands. The chromatophores are usually stellate, but often become degenerated and assume a subspherical form. The nucleus is often large and usually central. The genus is neritic and, although seldom found in great numbers, is spread widely, particularly in the southern hemisphere.

**Guinardia flaccida** (Castracane) H. Peragallo. (Pl. XI, fig. 5.)

Peragallo, H., 1892, p. 107, pl. 13, figs. 3, 4.
Hustedt, 1929, p. 562, fig. 322.
Lebour, 1930, p. 79, fig. 53.
Karsten, 1906, p. 161, pl. 29, fig. 4.
Gran, 1905, p. 24, fig. 25.
*Rhizosolenia? flaccida* Castracane, 1886, p. 74.
*Rhizosolenia Castracanei* Cleve, 1889, p. 54.
*Pyxilla baltica* Hensen, 1887, p. 87.

Cells usually large, solitary, but sometimes united to form short chains, seldom more than six cells to one chain. Cells cylindrical, often slightly flattened. Valve flat or nearly so, possessing a single rudimentary spine or spur placed near the margin. Connective zone composed of numerous narrow intercalary bands, which owing to the weakly siliceous nature of the cell are seen with great difficulty. If the cells are examined when mounted dry, the annular segments are seen more easily, although the cell is apt to collapse into an almost unidentifiable mass as a result of the drying. Chromatophores: numerous stellate or rounded bodies, equally spread throughout the cell connected by threads of plasma. Nucleus usually central. Diameter of cell 30–90$\mu$; pervalvar axis usually 60–90$\mu$.

A neritic species, which occurs in most European waters, but seldom in great numbers. It favours a high salinity and was observed frequently around the Cape of Good Hope.

Observed at Sts. 260, 300, 425, 433, 434, 435, 666, 675.

## Family LEPTOCYLINDRACEAE

### Subfamily *LEPTOCYLINDROIDEAE*

| | |
|---|---|
| 1. Cells tubular, valves flat, connective zone composed of segments arranged spirally | *Dactyliosolen* |
| 2. Cells tubular, valves flat or slightly convex, segments of connective zone not spirally arranged ... ... ... ... ... ... ... ... ... ... | *Leptocylindrus* |

## Genus **Leptocylindrus** Cleve

Cleve, 1889

A small genus with a true plankton habit. It is spread widely throughout the northern hemisphere and is represented in freshwater lakes as well as in the sea. It belongs to the "solenoid" group of diatoms, but unlike *Rhizosolenia*, the valves do not possess a mucro or any form of process. The development of the cell in the pervalvar axis is by means of numerous intercalary bands, but owing to the weakly siliceous nature of the cell wall, they are seen with difficulty. The cells are united by the valves to form chains or filaments, which are usually straight. Chromatophores: usually two, but may be numerous; nucleus central.

**Leptocylindrus danicus** Cleve. (Pl. XI, fig. 6.)

Cleve, 1889, p. 54.
Meunier, 1910, p. 258, pl. 28, figs. 31, 32.
Gran, 1905, p. 24, fig. 24.
Hustedt, 1929, p. 558, figs. 318, 319.
Lebour, 1930, p. 77, fig. 52.

Cells tubular, cylindrical, narrow, straight, united to form straight chains. Valves circular, flat or slightly convex, without mucro or any visible structure. Connective zone elongated, and bearing numerous pointed segments which fit together by their apices giving the connective zone an appearance of being composed of intercalary scale-like markings similar to many species of *Rhizosolenia*. Chromatophores: numerous cocciform bodies. Diameter of cell 5–18μ; pervalvar axis 30–65μ.

Probably a neritic species, but often found under oceanic conditions. It is spread widely throughout northern European waters and is encountered sometimes in enormous quantities. It was observed, but in small numbers only, in the Drake Straits and off the Cape of Good Hope. It occurred also in the Peru Current material, where the specimens were very much larger than those observed at the other two stations. Those from the Drake Straits were particularly small.

Observed at Sts. 381, 428; WS 710.

## Genus **Dactyliosolen** Castracane

Castracane, 1886

The genus *Dactyliosolen* is closely allied to *Leptocylindrus* and with it forms a sharply defined family. The "solenoid" formation of the cells reaches its highest expression in this family, and as the cells are perfectly symmetrical about the pervalvar axis, it is the furthest removed from the gonioid influence of the Biddulphiaceae. The valves are circular or discoid, and bear neither spine nor process. The zone of *Dactyliosolen* is composed of numerous and probably discontinuous annular imbricate segments which appear often to invest the cell with a certain spiral torsion.

It is probable that all the forms are truly oceanic. The genus is represented in both hemispheres, and in the sub-Antarctic Zone constitutes a considerable proportion of the total phytoplankton, where it forms a natural association with certain filamentous species of *Fragilariopsis*. Much research is required before the true relationship of all the forms is known. The type species, *Dactyliosolen antarcticus* Castracane, is unquestionably polymorphic, and much structural variation is found upon the connective zones of the several cells of one chain. It seems likely that two distinct groups can be recognized, the cold-water group comprising *Dactyliosolen antarcticus* and its various forms, and a warm-water group, *Dactyliosolen mediterraneus*. Chromatophores: numerous rounded bodies; nucleus usually central.

**Dactyliosolen antarcticus** Castracane. (Pl. VI, fig. 1.)

Castracane, 1886, p. 75, pl. 9, fig. 7.
Gran, 1905, p. 25, fig. 26.
Karsten, 1905, p. 93, pl. 9, fig. 10.
Lebour, 1930, p. 76, fig. 50.
Hustedt, 1929, p. 556, fig. 316.

Cells sometimes solitary, but usually united to form short chains of two to eight cells. Cells cylindrical, straight, valves flat or nearly so. Connective zone composed of numerous intercalary bands so arranged that the ends or seams of the bands form a spiral line about the pervalvar axis on the zone. Each intercalary band bears a line of oval or somewhat elongated puncta. These puncta have one end rounded and the other more or less square, and they decrease in size as the band approaches its oblique termination. Chromatophores: several rounded bodies, nucleus central. Diameter of cell 20–64$\mu$; pervalvar axis up to 130$\mu$.

*Dactyliosolen antarcticus* is a polyphasic species-system having a wide distribution in polar and sub-polar waters. The "*antarcticus*" phase occurs in both hemispheres and is common in the North Sea, and the North Atlantic. In the southern hemisphere it is seldom recorded north of latitude 40° S. It was observed very frequently, sometimes in great numbers around the South Sandwich Group, in the Drake Strait and particularly in the Southern Ocean a little below latitude 60° S, to the north of Enderby Land.

Observed at Sts. 365, 368, 369, 378–388, 453, 659, 661, 664, 666, 670, 1356, 1358, 1359, 1362.

"**borealis**" phase.

*Dactyliosolen borealis* Karsten.
Karsten, 1906, p. 160, pl. 29, fig. 1.

The "*borealis*" phase differs from the "*antarcticus*" phase only in the markings upon the intercalary bands. The bands are arranged in a similar fashion, so that the ends produce a spiral line upon the zone as in the type phase, but the markings take the form of lines or bars which completely cross the bands, dividing them into square compartments. The markings were clear and the zone was usually strongly siliceous. Diameter of cell 36–50$\mu$.

This phase was observed but seldom and specimens often showed a diphasic tendency, that is, they possessed markings characteristic of *D. antarcticus* at one end, and of *D. borealis* at the other end of the same cell. It was not found in very cold water.

Observed at Sts. 451, 664, 666.

"laevis" phase. (Pl. VI, figs. 2, 3.)

*Dactyliosolen laevis* Karsten.
Karsten, 1905, p. 93, pl. 9, fig. 11.
*Dactyliosolen flexuosus* Mangin, 1915, p. 57.

This phase is usually weakly siliceous, and varies from the preceding in the structure of the connective zone. The intercalary segments usually are narrow and upon the larger specimens squamose. The markings are indistinct, and are of the nature of short striations arranged in the pervalvar axis. The striae do not cross completely over the whole of the band, but fall short of the one margin, leaving a hyaline space. Diameter of cell 20–40μ; pervalvar axis 90μ.

Following the general habit of large polyphasic species-systems, specimens were observed exhibiting the "*antarcticus*" phase at one end of a chain, and the "*laevis*" phase at the other. Diphasic individuals, however, were not very common and the "*laevis*" phase possessed a definite geographical distribution and probably is neritic. I include in this phase *Dactyliosolen flexuosus* of Mangin. Mangin stated that he was unable to discover the fine longitudinal striation upon the connective zone but I have observed it upon many specimens although it must be admitted that the majority are hyaline. The flexuosity cannot be considered as a specific character, and is due probably to some pathological defect in the cells. The phase was observed in considerable quantities around South Georgia and the South Sandwich Group.

Observed at Sts. 336, 337, 460, 461, 463, 475, 477, 478, 479, 505–513, 570; WS 545, 548, 549, 550, 551, 552A.

**Dactyliosolen mediterraneus** H. Peragallo. (Pl. VI, figs. 4, 5, 6.)

Peragallo, H., 1892, p. 104, pl. 13, figs. 8, 9.
Hustedt, 1929, p. 556, fig. 317.
*Lauderia mediterranea* Peragallo, H., 1888, vol. XXIII, p. 81, pl. 6, fig. 45.
*Dactyliosolen meleagris* Karsten, 1906, p. 160, pl. 29, fig. 2.
*Dactyliosolen Bergonii* Peragallo, H., 1892, p. 104, pl. 13, fig. 6.

Cells cylindrical, straight, usually united to form short chains. Valves flat or nearly so. Connective zone composed of numerous intercalary bands. Bands of uniform width; margins parallel, with shortly conical ends, not oblique, as in *D. antarcticus*. The ends of the bands are arranged in a straight line one above the other, and do not form a spiral as in the preceding species. Sometimes the ends of the bands are indefinite, giving the cell wall an appearance of a continuous cylinder bearing a number of long marginal decussate lines, penetrating to the centre. Bands covered with a fine areolation, areoles rectangular, or nearly so, arranged somewhat in quincunx. Occasional bands are hyaline. Diameter of cell 16–34μ; pervalvar axis up to 80μ.

This species was observed at two stations only, to the south-east of Port Elizabeth.

It is fairly common in temperate and in tropical waters, particularly in the Mediterranean and the Indian Ocean.

Observed at Sts. 425, 433.

## Family CORETHRONACEAE

### Subfamily *CORETHRONOIDEAE*

1. Cells cylindrical, straight, valves furnished with circlet of long bristles directed towards the same pole, secondary corona of hairs bearing claws often present ... ... *Corethron*

### Genus **Corethron** Castracane

Castracane, 1886

The genus *Corethron* has received considerable attention of late, and most plankton workers are convinced of the close relationship that exists between the so-called species. I have expressed my own views on this subject on p. 216 and merely state here that I am confirmed in my belief of the specific unity of all the described forms. This monotypic genus presents a perfect example of what I mean by a polyphasic species-system, and can only be understood correctly if the species is conceived as an orbital system in a space-time continuum.

Under the name of the type-species I include all the described forms, and for the purpose of this paper, recognize five phases. The phases are not at all clear and the overlapping that occurs makes definition extremely difficult.

**Corethron criophilum** Castracane.

Castracane, 1886, p. 85, pl. 21, fig. 14.
*Corethron valdiviae* Karsten, 1905, p. 101, pl. 12, figs. 1–10.
*Corethron hystrix* Hensen, 1887, p. 89, pl. 5, fig. 49.
*Corethron inerme* Karsten, 1905, p. 104, pl. 13, figs. 11–17.
*Corethron Murrayanum* Castracane, 1886, p. 86, pl. 21, fig. 4.
*Corethron pelagicum* Brun, 1891, p. 20, pl. 19, fig. 6.
*Corethron hispidum* Castracane, 1886.

Under the name *Corethron criophilum*, I place as synonyms all the described forms. The large and plastic *Corethron* population, however, cannot be adequately described under any one name, but any attempt to arrange the names quoted above with a view to ascribing rank, subspecific or otherwise, would be very difficult. The acceptance of the orbital conception of a polyphasic species-system makes subspecific ranks unnecessary, and the following method of description does not attempt in any way to place in order of importance or to grant status or rank of any kind to the various phases, which have been chosen solely upon the ground that they portray adequately the *Corethron* population under consideration.

The following description has been framed to cover all the phases observed in the 'Discovery' material.

Cells usually solitary, but may be united to form chains. Cells cylindrical, length (pervalvar axis) from one and a half to fifteen times as long as the diameter. Valves circular, of varying degrees of convexity. Usually the convexity is greatest in the much elongated cells, and in these the short valve mantle may show a weak constriction. The valves are usually plain, but may bear a number of short spines or rudimentary granules. The margin of both valves is usually furnished with a circlet of bristles, which are directed towards the same pole, and make an angle from 30° to 65° with the pervalvar axis of the cell. The bristles are straight or only slightly curved and taper to a fine point. They may be plain or armed with small spines, they may be thin and hair-like or flattened on either side of a central rib.

The connective zone may be thick or thin, composed of a simple hyaline tube, or numerous scale-like intercalary bands, or numerous annular segments. All combinations of the above characters are often found upon the same specimen. Chromatophores: numerous rounded or oval bodies, spread throughout the cell upon thin strands of plasma. Nucleus central.

Karsten described microspores. I have observed numerous inclusion bodies similar to those recorded by Karsten, and identical bodies embedded in a mucilaginous film in the Ross Sea. These bodies absorbed stain in the same way as nuclear substance.

| "*criophilum*" phase | "*hispidum*" phase | "*hystrix*" phase | "*inerme*" phase | "*pelagicum*" phase |
|---|---|---|---|---|
| 5 × 20 | 15 × 75 | 20 × 40 | 30 × 40 | 80 × 90 |
| 5 × 30 | 20 × 80 | 20 × 60 | 30 × 90 | 80 × 120 |
| 5 × 45 | 20 × 120 | 20 × 80 | 30 × 150 | 100 × 100 |
| 6 × 30 | 40 × 60 | 20 × 100 | 40 × 200 | 100 × 120 |
| 6 × 45 | 60 × 80 | 25 × 100 | 40 × 350 | 100 × 160 |
| 6 × 60 | | 25 × 120 | | 100 × 180 |
| 6 × 72 | | 40 × 100 | | 140 × 160 |
| 8 × 60 | | 40 × 150 | | |
| 8 × 80 | | 40 × 200 | | |
| 8 × 100 | | 40 × 280 | | |
| 8 × 120 | | 60 × 320 | | |
| 10 × 60 | | | | |
| 10 × 120 | | | | |
| 10 × 150 | | | | |
| 20 × 96 | | | | |
| 20 × 120 | | | | |
| 20 × 200 | | | | |

It would be impossible to express the size of the specimens of any phase by one set of dimensions only, owing to the enormous range which was observed, and as the *Corethron* population is without question the most important constituent of the South Atlantic phytoplankton the opportunity has been taken to record several dimensions in order to convey some idea of the size variation that exists in each phase. During this work several thousand measurements of *Corethron* were made in an attempt to correlate the phases, and it was found that the measurements of each phase could be arranged in an order of even gradation and that as far as measurements were concerned the phases merged into one another as a continuous chain. The adjacent selection of dimensions gives some idea of the variation met with. The dimensions (in microns) are arranged as: diameter of cell × pervalvar axis.

The names chosen to describe the phases are placed in order of priority. In order to render the distribution more clear, the stations at which all phases of the *Corethron* population occurred are quoted below together, and the distribution is expressed in general terms under the phase titles.

Observed at Sts. 300–305, 334–340, 365, 368, 378–388, 433, 436, 439, 450–453, 460, 461, 463, 475, 477–483, 501–508, 511–513, 542–544, 551–553, 574–578, 580, 615, 617, 619, 626, 661, 663, 664, 666, 670, 1356, 1358, 1359, 1362, 1369; WS 100, 101, 106, 469, 474, 481, 540–543, 545, 547–552A, 569, 571, 593, 594, 598, 600–602, 621–623, 640, 644, 703, 705, 706, 710; MS 86, 94, 97, 99; RS 9, 17, 19, 20, 23, 27.

"**criophilum**" phase. (Pl. VII, figs. 2–10; pl. VIII, figs. 3–6.)

This might be described as the type phase, and to take Castracane's own words, "this long and perfect little cylinder has a longitudinal axis, which bears to its diameter the ratio of 14 to 1. The awns are long and very delicate, smooth and radiating in the same direction at the two extremities. The two valves are extremely convex".

The illustration provided by Castracane shows a plain, hyaline, thin-walled cell, provided at both ends with a circlet of long bristles surrounding the deeply convex valves. The valves are sometimes constricted in the valve mantle. This thin-walled phase is probably a summer form or a special form produced from microspores. It was observed in the Atlantic from time to time, particularly at Sts. 664, 666 and 670 upon the 30th W meridian, where the specimens compared exactly with Castracane's description and illustration. It was observed in very large numbers in the Ross Sea material but here the cells were exceedingly small and very weakly siliceous. In this area also, it was observed that *Corethron* adopts the colonial habit and large numbers often were encountered embedded in a mucilaginous film. These colonies were of considerable size, often as many as several hundred cells being so united. The mucilaginous groundwork of the film would assume a pale purplish-blue colour when stained with methylene blue, and large numbers of small granules were embedded in it which absorbed the dye very readily, assuming a blue-black colour. The small cells embedded in the film absorbed the dye but weakly, assuming a pale blue colour, but the cytological elements within them were stained very darkly. It is probable that the heavily stained granules were microspores, and development from these accounted for the uniformly small cells observed in this area. It is probable that the mucilaginous habit is adopted as protection against the severe climatic conditions which prevail so far south, and owing to the shortness of the season, the production of microspores would be the only method that would enable the flora to reproduce effectively and maintain the standard of productivity that is so constant a character in polar waters. In the Ross Sea, *Corethron criophilum* existed in a pure state but was sometimes found associated with several species of *Chaetoceros*.

This phase was observed in the South Atlantic Ocean, the Ross Sea, and the Weddell Sea.

"**hispidum**" phase. (Pl. VIII, figs. 7, 8.)

This phase is portrayed by Castracane's species *Corethron hispidum* and *Corethron Murrayanum*. The cells are strongly siliceous and vary considerably in size. The pervalvar axis may be only just a little longer than the diameter, or may be six or seven times as long. As usual in *Corethron* the greater the diameter of the cell, the less is the convexity of the valve. The valve possesses several short spines dotted irregularly over the surface; sometimes they are numerous and very prominent, but they may be much reduced, rudimentary, or absent. The spines are not furnished with terminal claws. The bristles which surrounded the valve are strongly developed, but not very numerous. Each bristle is somewhat flattened on either side of a central rib; it is broad as it leaves the valve-mantle, but tapers to a fine point, and is armed throughout its entire length with coarse spines. The connective zone is usually composed of annular segments sometimes very clearly marked, but they may be indistinct. Some of the small and narrow specimens were marked clearly with annular segments towards the centre of the connective zone, but showed distinct imbricate scales towards the valves.

This phase was observed but seldom and appeared to be confined to warm waters. It was observed off the coast of Natal and between the Cape of Good Hope and Bouvet Island.

"**hystrix**" phase. (Pl. VII, fig. 1; pl. VIII, fig. 1.)

This is the broadest phase of the species and that most commonly met with in the northern hemisphere. It is portrayed in *Corethron hystrix* Hensen and *Corethron valdiviae* Karsten. The phase is very complex and epiphases occur which make delineation impossible. In the southern hemisphere, particularly in the sub-Antarctic Zone, the strongly developed and relatively thick-walled specimens described by Karsten exist in enormous quantities. The cells, which often attain considerable size, are usually from four to ten times as long as they are broad. The valves are of varying degrees of convexity and seldom constricted as they approach the connective zone. The valves are furnished with a marginal circlet of long and well-developed bristles. The bristles are usually half as long again or more than the pervalvar axis of the cell, and taper to a fine point, making an angle of approximately 45° with the main axis of the cell. The bristles are armed with very small spines. The valves are furnished also with a corona of shorter and much finer bristles or hairs which stand erect upon the valve margin, and are not bent back in the same manner as the large bristles, but form a small cluster or tuft. These fine hairs are furnished with stout terminal claws which act as coupling hooks, uniting the cells into short chains. This corona of fine hairs may be present at one end of the cell only. The connective zone is composed of numerous scale-like intercalary bands, which are sometimes very difficult to see, and are often interrupted by hyaline spaces.

This phase is very widespread in the Southern Ocean and the South Atlantic, and was encountered, sometimes in enormous quantities, around South Georgia, the South Sandwich Group and the South Shetlands. It was common in the Peru Current, but was not observed in the material from the stations in the Brazil Current. This phase, which was represented in the south by large and usually well-developed specimens, was found often mixed with less strongly siliceous, and often smaller specimens which exhibited certain "*criophilum*" phasic influences. These specimens possessed relatively thin walls and the bristles were about the same length as the pervalvar axis of the cell, seldom bearing spines, and making an angle with that axis of about 60°. The corona of fine hairs was seldom present, and if present, very difficult to see. The connective zone was thin and the scale-like markings frequently were absent or visible only in certain areas on the connective zone.

The "*hystrix*" phase is represented in the northern hemisphere by these smaller and less strongly siliceous specimens. It is common in the North Atlantic and has been observed in the North Sea, English Channel and the China Seas. It was observed frequently in the Southern Ocean, common around the south of Africa, Bouvet Island, the Weddell and Bellingshausen Seas, and in the Drake Strait.

"**inerme**" phase. (Pl. VIII, fig. 9.)

This phase is probably seasonal, but the areas in which it was observed are very limited. The cells are robust, usually strongly siliceous, and united to form straight chains. The formation of the chain is rather peculiar, as all the cells are retained within the parent connective zone, and bristles are observed only upon the terminal cells. Frequently the bristles are not free, but held within the connective zone, giving the zone the appearance of being longitudinally striate. In some specimens the bristles are entirely absent. Terminal coronas of hairs are seldom present. Owing to this method of chain formation, the valves are only weakly convex.

Specimens typical of this phase were observed off South Georgia, and again a little below latitude 60° S, to the north of Enderby Land.

From the illustrations provided by Karsten, it is clear that he encountered this phase also, and created for it a new specific name (Karsten, 1905, p. 104, pl. 13) which has been adopted to describe this phase.

"**pelagicum**" phase. (Pl. VIII, fig. 2.)

This phase was encountered but rarely and must be regarded as a warm-water phase. It corresponds to *Corethron pelagicum* Brun. The chief differences between it and the other phases are considerable shortening of the connective zone, and increased diameter of the cell. This phase is found living free. The diameter of the valve is usually from 100–150$\mu$, and the pervalvar axis of the cell is seldom more than 180$\mu$. The cells are often quite spherical, the valves being fully rounded as a part of a circle. The bristles are numerous and relatively short. The chromatophores are numerous cocciform bodies, often clustered together.

This phase was observed in small numbers only around South Africa. It is said to be common in the Mediterranean.

## Suborder ARAPHIDINEAE

## Family FRAGILARIACEAE

### Subfamily *FRAGILARIOIDEAE*

| | | |
|---|---|---|
| 1. | Cells linear, united in ribbon-like bands, valves finely striate, narrow axile area | *Fragilaria* |
| 2. | Cells linear to linear-lanceolate, united in ribbon-like bands, axile area absent, transverse lines of puncta alternate with hyaline ridges | *Fragilariopsis* |
| 3. | Cells solitary or in tufted colonies, valves striate, small rounded or rectangular central area present | *Synedra* |
| 4. | Cells united in zigzag chains, valves usually hyaline, marginal spines | *Thalassionema* |
| 5. | Cells solitary, spirally twisted or slightly sigmoid, apices sometimes unequal | *Thalassiothrix* |
| 6. | Cells clavate, arranged in stellate or spirally twisted colonies | *Asterionella* |

### Subfamily *TABELLARIOIDEAE*

| | | |
|---|---|---|
| 1. | Cells rectangular, united in zigzag chains, internal septa straight | *Rhabdonema* |
| 2. | Internal septa undulate | *Grammatophora* |
| 3. | Cells cuneate in girdle view, clavate in valve view | *Licmophora* |
| 4. | Cells linear in valve view, arcuate in girdle view | *Entopyla* |

### Subfamily *FRAGILARIOIDEAE*

#### Genus **Fragilaria** Lyngbye

Lyngbye, 1819

This genus is represented by several species, all of which are neritic. The species are colonial, and the cells adhere valve to valve, giving rise to flat ribbon-like bands. Some of the species recorded were associated with melting ice, and those obtained near St. 560 were obtained from melted ice taken at a position in approximately 66° S, 69° W. These included *Fragilaria curta* which must be considered as characteristic of the coastal diatom flora of the land-masses within the Antarctic convergence.

**Fragilaria curta** Van Heurck.

Van Heurck, 1909, p. 24, pl. 3, fig. 37.

Cells small, united to form short chains, but often solitary. Valves oblong, with rounded ends, sides straight, parallel. Valve-surface furnished with numerous delicate transverse striae. Striae straight and parallel in the median area of the valve, but slightly curved towards the apices. Connective zone simple. Chromatophores: several small plates. Apical axis of cell 24–30$\mu$; transapical axis 8$\mu$. Type locality, melted ice from Antarctic Ocean.

Probably a neritic species: obtained in great numbers from melted ice.

Observed near St. 560.

**Fragilaria granulata** Karsten.

Karsten, 1907, p. 396, pl. 54, fig. 8.

Cells united to form short chains, from four to twelve cells in a chain. Chains curved in a horse-shoe fashion. Valves linear-lanceolate in outline, valve surface slightly inflated, and furnished with numerous transverse lines, connective zone simple. Chromatophores: numerous cocciform bodies, nucleus somewhat large, central. Apical axis of cell 40–56μ.

Probably neritic, common in the warmer waters around South Africa.

Observed at Sts. 260, 261, 262, 263, 264, 431, 432, 434; WS 630, 631, 706, 707.

**Fragilaria linearis** Castracane.

Castracane, 1886, p. 56, pl. 19, fig. 9.
Heiden and Kolbe, 1928, p. 550, pl. 6, fig. 128.

Cells linear, united to form flat ribbon-like chains. Valves flat, with apices rounded, and lateral margins straight. Valve surface furnished with numerous fine transverse striae. Connective zone well developed, simple. Chromatophores: several small plates adhering to the valves. Apical axis of cell 50μ; transapical axis 6–8μ. Type locality, Antarctic Ocean.

Castracane pointed out that in the perfectly linear outline of the valve this organism differed from any previously recorded species of this genus.

The species was observed in water obtained from melted ice.

Observed near St. 560.

**Fragilaria striatula** Lyngbye.

Lyngbye, 1819, p. 183, pl. 63.
Gran, 1905, p. 113.

Cells united to form chains, seldom solitary. Valves narrowly lanceolate, with apices somewhat attenuate. Valve with narrow median pseudoraphe. Valve surface covered with delicate transverse striae. Connective zone composed of numerous plicae. Apical axis of cell 30μ; transapical axis 5μ.

A weakly siliceous, marine Fragilaria, usually associated with a coastal flora, but often found in the plankton. It has been recorded from the Atlantic coasts of most European countries. It was observed, but in a small quantity only, around South Georgia, and at two stations in mid-Atlantic on the 30th W meridian.

Observed at Sts. 475, 671, 677.

### Genus **Fragilariopsis** Hustedt

Hustedt, in Schmidt, 1913

The genus *Fragilariopsis* was created by Hustedt (Hustedt, in Schmidt, 1913, pl. 299), to accommodate *Fragilaria antarctica* Castracane (Castracane, 1886, p. 56). The division was well-founded, for the type-species of Hustedt's genus differed in structure from *Fragilaria* in more than one respect. The valve surface of *Fragilariopsis antarctica* possesses no median hyaline area or pseudoraphe in the apical axis of the cell, which is a constant character in the genus *Fragilaria*. In *Fragilariopsis* the markings are uninterrupted, and consist of transverse lines of puncta alternating with hyaline folds or ridges.

Fritsch (1912, p. 49) and Carlson (1913, p. 31) placed *Fragilaria antarctica* into the genus *Denticula* Kützing. This is to misunderstand entirely the structure of *Denticula*, for that genus possesses a prominent canal-raphe and intercellular craticular structures, neither of which is present in *Fragilariopsis*. Heiden and Kolbe (1928) added to *Fragilariopsis* two species previously described by Van Heurck (1909) as species of *Fragilaria*.

**Fragilariopsis antarctica** (Castracane) Hustedt in Schmidt. (Pl. XIII, figs. 11, 12.)

Hustedt, in Schmidt, 1913, pl. 299, figs. 9–14.
*Fragilaria antarctica* Castracane.
Castracane, 1886, p. 56, pl. 25, fig. 12.
Karsten, 1905, p. 122, pl. 17, fig. 7.

Cells sometimes single, but usually united to form long ribbon-like chains. Chains straight. Valves slightly convex, sometimes flat, elliptic-lanceolate in outline, apices rounded. Valve-surface furnished with two systems of markings. The main structure of the valve consists of a grill or framework, in the form of several, usually five to thirty, stout bars, arranged transapically, which connect with a strong marginal valve-rim. Between the transverse bars, and upon a lower plate, are numerous puncta, usually arranged in two parallel lines. The connective zone is narrow and simple. The cell is strongly siliceous, and from examinations of deep-sea muds made in the neighbourhood of Tristan d'Acunha, it is evident that an enormous bed of diatomaceous earth is in the process of formation, which consists very largely of the frustules of this species. Chromatophores: two elongated plates, lying close to the valves, nucleus central. Transapical axis 6–14$\mu$; apical axis 20–80$\mu$.

One of the most common Antarctic diatoms, often found in enormous quantities, probably oceanic. It is liable to considerable variation in size and shape, and in the number of transverse bars upon the valve surface.

Observed at Sts. 300–302, 365, 368, 378–386, 388, 451–453, 460, 461, 463, 475, 477–482, 501, 504–508, 511–513, 542, 544, 552, 560, 570, 574, 575, 577, 578, 617, 659, 661, 666, 670, 1356, 1359, 1362, 1369; WS 469, 474, 481, 541, 542, 543, 545, 547–552A; RS 9.

"**bouvet**" phase.

*Fragilaria antarctica*, forma *bouvet* Karsten, 1905, p. 123, pl. 17, fig. 10.

This is very similar to the type phase, and is found associating with it. It differs in possessing a more regularly rectangular girdle view, so that the cells lie closely adpressed throughout the whole of their length when in chain formation. The markings upon the cell are usually less vigorous, the chromatophores usually smaller, and the cells show greater regularity in size and shape. Transapical axis 8–14$\mu$, apical axis 20–40$\mu$. Probably a neritic phase.

Observed at Sts. 460, 461, 576, 577, 615, 617, 619; WS 481.

**Fragilariopsis sublinearis** (Van Heurck) Heiden and Kolbe.

Heiden and Kolbe, 1928, p. 554.
*Fragilaria sublinearis* Van Heurck, 1909, p. 25, pl. 3, fig. 39.

Cells united to form short chains, but often solitary. Valves linear or weakly linear-lanceolate, tapering slightly towards the apices. Apices rounded. Valve-surface furnished with delicate moniliform striae, puncta more distinct towards the apices. Connective zone simple. Apical axis of cell 50–70μ; transapical axis 5–7μ. Type locality, melted ice from the Antarctic Ocean.

This diatom was frequently observed around the coasts of South Georgia, particularly in East Cumberland Bay.

Observed at Sts. MS 86, 88, 89, 90, 92, 95, 97, 98, 99, 100–103.

### Genus **Asterionella** Hassall ex Wm Smith.

Wm Smith, 1856
[Hassall, 1850]

The genus *Asterionella* is usually attributed to Hassall (Hassall, 1850, p. 9), who first used the name *Asterionella formosa* as a *nomen nudum* in his indictment of the several water companies which supplied the Metropolitan area during the nineteenth century. Upon the following page the name was used again in the following manner: "The stelliform *Diatoma*, to which I have given the name *Asterionella formosa*". Reference was made to a plate. Although the illustration provided clearly represents the organism known to-day as *Asterionella formosa*, and shows that there might be a case for regarding the above quotation as a description of the species observed by Hassall, no description of the genus appeared which would warrant the authority being attributed to him. I have attributed the genus to Wm Smith, who described it fully (Smith, 1856, p. 81) and provided descriptions of three species.

**Asterionella japonica** Cleve et Möller ex Gran. (Pl. XI, fig. 3.)

Gran, 1905, p. 118, fig. 160.

Cells united to form spiral star-shaped colonies, eight to twenty cells to a colony. Cells having one end inflated into a triangular head, while the other end is produced into a narrow rod-like outer portion. Valve possessing a narrow pseudo-raphe. Chromatophores: usually two, confined to the broad end of the cell. Apical axis of cell 50–90μ; inflated portion, about one-quarter of the total length.

A neritic species, common in temperate seas.

The name *Asterionella japonica* first appeared in lists which accompanied sets of microscopic slides issued by Cleve and Möller in 1877–1882, but as such, must be considered as a *nomen nudum*, with no legal standing. I have attributed the authority for the name to Gran, who first gave it legal publication.

Observed at Sts. 1373; WS 700.

**Asterionella notata Grunow ex Van Heurck.**

Van Heurck, 1881, pl. 52, fig. 3.
Gran, 1905, p. 119.

Cells united to form irregular elongated chains, adhering by their thickened ends, usually radiating about a common axis, but sometimes arranged about more than one axis. Valves slightly broader at one end, tapering gently to a fine point at the other. A faint median pseudoraphe present. Girdle simple. Chromatophores: numerous cocciform bodies. Apical axis of cell, 60–96$\mu$. Type locality Honduras.

A neritic species common in the warmer water of the southern hemisphere.

Observed at St. 1373.

## Genus Synedra Ehrenberg

Ehrenberg, 1830

The name *Synedra* was used first by Ehrenberg in 1830 in the following manner (p. 40): "*Synedra* nov. Gen. *affixa pedicellata saepe dichotoma, apica dilatata.*"

As far as I can ascertain no species was described under this generic heading in the 1830 publication quoted above. In 1832 Ehrenberg 1832, p. 86 described five species of *Synedra* under the following epithets: *S. fasciculata*, *S. lunaris*, *S. bilunaris*, *S. balthica*, *S. Vlna.*

In *Infusionsthierchen*, 1838, p. 210, Ehrenberg redescribed the genus and added descriptions of six species, which included those previously described in 1832, either retaining them with specific rank, or placing them in the synonymy of new combinations there described for the first time. *Synedra baltica* was placed in the synonymy of *Synedra Gallionii*, which was based on *Navicula Gaillonii* of Bory (*Encyclopédie méthodique*, 1824). *Synedra lunaris* and *Synedra bilunaris* subsequently were transferred to the genus *Eunotia* by Grunow in Van Heurck's Synopsis (pl. 35, 1881). As there appears to be some doubt as to the identity of *Synedra fasciculata* Ehrenberg, I consider *Synedra ulna* Ehrenberg as the type of the genus.

**Synedra auriculata Karsten.**

Karsten, 1906, p. 173, pl. 30, fig. 18.
Skvortzow, 1931 *b*, p. 112, pl. 10, fig. 2.

Cells very long and narrow, often matted together in dense masses. The diameter of the cell is uniform throughout the greater part of the length, but decreases slightly a short distance from the slightly inflated apices. Apices rounded. Median pseudo-raphe prominent. Short transverse striae present throughout the whole length of the cell, a little more closely arranged towards the apices than in the middle area. Chromatophores: numerous cocciform bodies. Apical axis of cell 800–1200$\mu$, transapical axis 4–6$\mu$. Type locality, off the coast of South Africa.

Observed at St. WS 481.

**Synedra pelagica** Hendey, nom.nov.

*Synedra spathulata* Schimper ex Karsten, 1905, p. 124, pl. 17, fig. 11.
non *Synedra spathulata* O'Meara, 1875, p. 310, pl. 28, fig. 34.

Cells very long and narrow, hair-like, often matted together in dense masses. Cells slightly inflated towards the centre and at the ends, but not abruptly so. Cells often curved, sigmoid, or twisted. Valve surface bears very faint short striae, often seen only upon the terminal inflations. Chromatophores: numerous elongated bodies scattered throughout the whole length of the cell. Apical axis of cell 800–2400$\mu$, transapical axis 5–9$\mu$. Type locality Antarctic Ocean.

This organism is often found in enormous quantities in the Southern Ocean and was described by Karsten (1905) as appearing in Schimper's note-book as *Synedra spathulata*, n.sp. This name, however, was preoccupied (O'Meara, 1875). The new name *Synedra pelagica* is used to describe the form mentioned by Schimper (in MSS.) and by Hart (1934, p. 167).

Observed at Sts. 432, 577, 666, 671, 673; WS 666.

**Synedra stricta** Karsten.

Karsten, 1906, p. 173, pl. 30, fig. 19.

Cells very long and narrow, straight, often in dense masses. Valves of uniform diameter throughout the whole length, no median or terminal inflations. Apices rounded, not spatulate or bulbous. Valve furnished with a prominent pseudoraphe, and numerous fine short transverse striae. Chromatophores: numerous rounded or rod-shaped bodies. Apical axis of cell 750–2000$\mu$, transapical axis 6–8$\mu$. Type locality, Port Elizabeth.

Probably a neritic species, common around South Africa.

Observed at Sts. 434, 435, 436, 438, 439.

## Genus **Thalassiothrix** Cleve et Grunow

Cleve et Grunow, 1880

**Thalassiothrix acuta** Karsten.

Karsten, 1906, p. 173, pl. 30, fig. 20.

Cells very long and thin, forming long tangled masses. The cell shows often a certain amount of torsion about the apical axis, but seldom sigmoid as in many similar forms. Apices attenuate. Valve furnished with a narrow and indistinct pseudoraphe, and fine transverse striae. Chromatophores: numerous small rounded bodies. Apical axis 1–2 mm.; transapical axis 4–6$\mu$.

Observed at Sts. 434, 435, 437, 438, 439; WS 481, 646.

**Thalassiothrix antarctica** Karsten.

Karsten, 1905, p. 124, pl. 17, fig. 12.
Skvortzow, 1931 *a*, p. 80, pl. 2, fig. 5.

Cells linear, very long, often bent in the form of an S. Valves with parallel sides and rounded apices. Striations upon the valve margins very fine. Chromatophores: numerous rounded bodies. Apical axis of cell 1–3 mm.

This form has a wide distribution in the South Atlantic, Pacific and Indian Oceans. It has been reported by Skvortzow from the China Seas. It was observed often in considerable quantity in the Peru Current material.

Observed at Sts. WS 598, 600, 601, 602.

**Thalassiothrix longissima** Cleve et Grunow.

Cleve and Grunow, 1880, p. 108.
Karsten, 1905, p. 124.
Lebour, 1930, p. 198, fig. 159.

Cells solitary, often found in large tangled masses. Cells very long and thin, often slightly curved. Poles of the cells tapering very slightly, one usually more than the other, and each bearing two small apiculi. Valves minutely striate, bearing numerous marginal apiculi, apices bluntly rounded. Chromatophores: numerous cocciform bodies. Apical axis of cells up to 3–4 mm.

This species is widely distributed throughout the colder waters of both north and south hemispheres. It was observed, sometimes in enormous quantities, around South Africa, and particularly in that part of the Southern Ocean which lies to the south of that continent, between it and Enderby Land.

Observed at Sts. 424, 427, 428, 436, 439, 440, 450, 460, 670, 1356, 1358, 1359; WS 598.

### Genus **Thalassionema** Grunow ex Hustedt

Hustedt, 1932

[Grunow ex Van Heurck, 1881–85]

The genus *Thalassionema* has often been attributed to Grunow because of the explanatory note made by him upon pl. 43 of Van Heurck's Synopsis (1881–85) under *Thalassiothrix nitzschioides* Grun., which was as follows: "On pourrait peut-être en créer un nouveau genre nommé *Thalassionema*."

Owing to the vague mention of the proposed new genus, and the fact that no specific epithet was used in combination, Grunow's publication of this name must be ruled as invalid. The authority is attributed to Hustedt who gave a full generic description, followed by a description of *Thalassionema nitzschioides*.

**Thalassionema nitzschioides** Hustedt.

Hustedt, 1932, p. 244, fig. 725.

Cells united to form stellate or zigzag colonies. Valves linear, with parallel sides and bluntly rounded apices. Valve surface structureless, but the margins are furnished with minute spinulae. Connective zone simple, having a rectangular aspect. Chromatophores: numerous cocciform bodies. Apical axis of cell 30–90$\mu$, transapical axis 2–5$\mu$.

A very common pelagic diatom, frequently observed around the coasts of European countries and in the North Atlantic Ocean. It was observed, sometimes in considerable numbers, around South Africa and in the Peru Current material from the Pacific.

Observed at Sts. 425, 427, 428, 431, 433, 434, 435, 440, 1373; WS 580, 709, 710, 713.

### Genus **Licmophora** Agardh

Agardh, 1827

**Licmophora luxuriosa** Heiden et Kolbe.

Heiden et Kolbe, 1928, p. 572, pl. 6, figs. 140, 141.

Cells rather large. Valve clavate, apices rounded. The apex at the broad end of the valve not bluntly rounded, but very slightly attenuate. The greatest diameter of the valve is at about one-fifth of the valvar distance from the broad end, after which the valve tapers very gently towards the narrow apex. The valve bears a median pseudoraphe and numerous transverse coarse striae. In girdle view the cell is broadly cuneate with a complex connective zone, showing the characteristic septa. Between the septum and the valve margin is a long and narrow cuneate area, which is minutely punctate. These small puncta are arranged in transverse lines. Chromatophores: several rounded bodies. Apical axis of cell, 110–210$\mu$, greatest transapical axis 18–26$\mu$. Type locality, Observatory Bay, Kerguelen.

A stipitate epiphytic diatom characteristic of the Southern Ocean. A few isolated specimens were observed in the South Atlantic, St. 670, but it occurred in considerable numbers in the Bransfield Strait.

Observed at Sts. 670; WS 481.

**Licmophora Lyngbyei** (Kützing) Grunow ex Van Heurck.

Van Heurck, 1880–5, p. 158, pl. 46, fig. 1.
Lebour, 1930, p. 203, fig. 165.
*Podosphenia Lyngbyei* Kützing, 1844, p. 121.

Cells colonial, united by means of mucous stipes to form dense tufts. Cells in valve view clavate, the broad end rounded; in girdle view, broadly cuneate somewhat triangular. Valve flat, furnished with fine transverse striae and a prominent pseudoraphe. Connective zone cuneate, showing numerous septa. Chromatophores: numerous cocciform bodies. Apical axis of cell 54–80$\mu$.

This organism is widespread in both the northern and southern hemispheres; in the latter it is very abundant. No appreciable difference was observed between the forms so widely separated. A very common littoral diatom often epiphytic upon kelp and frequently observed epizootic upon the legs of small crustaceans.

Research into the nomenclature of this species reveals an interesting history. The organism has been referred to many earlier names, the earliest being *Echinella cuneata* Lyngbye (1819), but lack of precision in the description and the crudity of the illustration make it impossible to say with any degree of certainty that the organism here referred to is synonymous with Lyngbye's species. If we find we are unable to accept *Echinella cuneata* Lyngbye, we cannot recognize any subsequent name which is based wholly on it. Agardh (1831) published the name *Licmophora abbreviata*, based on Lyngbye's *Echinella*. This has been accepted by Hustedt (1931), but as Agardh adds little to the description and offers no illustration, we are thrown back entirely on to Lyngbye's species, which I am unable to accept. In any case the combination *Licmophora abbreviata* is illegal, for if the organism named by Agardh was identical with Lyngbye's species, the name should have been *Licmophora cuneata*.

*Podosphenia abbreviata* Ehrenberg (1838) has also been used for this organism, but we find that Ehrenberg's name was based upon earlier names, including *Echinella cuneata* Lyngbye, all of which Ehrenberg himself questioned. In this case the doubtful synonyms quoted by Ehrenberg can be entirely disregarded and *Podosphenia abbreviata* Ehrenberg must stand by itself. Even if we are satisfied that our organism is identical with *Podosphenia abbreviata* Ehrenberg (1838), we cannot accept the specific epithet in the combination *Licmophora abbreviata* as that name was preoccupied (Agardh, 1831). The next name associated with this organism was *Podosphenia Lyngbyei* Kützing (1844), and again *Echinella cuneata* Lyngbye was given as a synonym. Whether Kützing made an error of identification or not is a matter of no importance to us, for although we might still refuse to accept Lyngbye's species, the description and illustration provided by Kützing undoubtedly refer to the specimen we have under consideration, and we are thus provided for the first time with a name we can use. It might be suggested that Kützing should have made the combination *Podosphenia cuneata* if he was satisfied with Lyngbye's species; but this he could not do, as that name was preoccupied (*vide* Kützing, 1844), and he was forced to provide a new epithet.

Grunow in Van Heurck (1880–85) supplies the new combination *Licmophora Lyngbyei*, based on *Podosphenia Lyngbyei* Kützing. Grunow's name has been adopted in this work, as it proved to be correct within the meaning of the Rules of Nomenclature, and it enables us to establish beyond all doubt the identity of our organism.

Observed at Sts. 304, 542, 544; WS 708; MS 89, 90, 92, 95, 97, 98, 99, 100, 103.

## Genus **Grammatophora** Ehrenberg

Ehrenberg, 1840*a*

### **Grammatophora kerguelensis** Karsten.

Karsten, 1905, p. 125, pl. 17, fig. 14.

Cells united by their corners to form zigzag chains. Valves narrow, and mostly flat, having slight median and terminal inflations, apices rounded. Valve surface furnished with fine transverse striation. Connective zone well developed; it shows the characteristic septa which penetrate the valve entirely, leaving free a small central area only, usually occupied by the nucleus. The septa undulate slightly. Chromatophores: numerous small vermiform bodies. Apical axis of cell 120$\mu$, transapical axis 12–16$\mu$.

A neritic and littoral diatom, seldom found in the plankton proper; chiefly epiphytic upon rocks and larger algae.

Observed at St. WS 481.

**Grammatophora serpentina** Ehrenberg.

Ehrenberg, 1844, p. 203.

Found associated with the preceding species. In no respect do the specimens differ from those commonly found in Europe. The cells differ from those of the previous species in that they possess no median inflation, and that they taper slightly towards the extremities. Valves linear, apices rounded. Striae upon the valve surface a little more vigorous than those of *G. kerguelensis*. Apical axis of cell 80–120$\mu$.

A neritic and littoral species widely spread throughout temperate coastal waters.

Observed at St. WS 481.

## Genus **Rhabdonema** Kützing

Kützing, 1844

Mann (1907, p. 321) pointed out that *Rhabdonema* was truly synonymous with the genus *Tessella* Ehrenberg (1838, p. 202), and that the type-species of the latter, *Tessella catena*, was identical with *Rhabdonema arcuatum* Kützing. This was recognized also by Kützing. In *Diatoms of the Albatross Voyages* (1907) Mann restored *Tessella*, but abandoned it later in his *Marine Diatoms of the Philippine Islands* (1925). The name *Rhabdonema* is used here in the sense in which Kützing used it, until it is conserved.

**Rhabdonema adriaticum** Kützing. (Pl. XI, fig. 2.)

Kützing, 1844, p. 126, pl. 18, fig. 7.
Lebour, 1930, p. 202, fig. 164.

Cells quadrangular in zonal aspect, united to form chains. Valves linear-lanceolate in outline. Apices rounded, very slightly swollen, plain. Pseudoraphe narrow, linear. Valve surface covered with parallel striae arranged either side of the pseudoraphe; striae slightly divergent towards the apices. Connective zone very strongly developed, striate, furnished with numerous septa. Chromatophores: numerous irregular or stellate bodies. Apical axis of cell 100–130$\mu$.

A littoral form common around the shores of all European countries, the Atlantic, and the Pacific coasts.

Observed at Sts. WS 622, 623.

## Genus **Entopyla** Ehrenberg

Ehrenberg, 1848

Most authors give 1841 as the date of publication of this genus, citing a figure, namely 9*b* of section 1, plate 1, of Ehrenberg's work on the microscopic organisms of North and South America, which appeared in the *Abhandlung der Akademie der Wissenschaft zu Berlin* (1841) 1843. This however is quite in error. Fig. 9*b* of the above mentioned plate was described as a fragment of *Surirella australis*, and it was upon this species that Ehrenberg created the genus *Entopyla* in 1848.

**Entopyla kerguelensis** Karsten.

Karsten, 1905, p. 125, pl. 17, fig. 15.

Cells large, often united to form short chains, but may be solitary. Valves dissimilar, somewhat linear in outline, with weakly inflated apices, and a weak median constriction. Apices slightly produced, obtusely rounded. The inferior valve is concave and possesses prominent terminal nodules, nodules broadly oval. The superior valve is convex, and without the terminal nodules, but the apices are very slightly recurved. The valve surface is furnished with strong costae arranged on either side of a median line; costae not continuously transverse, but slightly divergent in the apical areas and almost parallel in the median area of the valve. Connective zone well developed, showing numerous internal septa. Chromatophores: numerous cocciform bodies. Apical axis of cell 120–136μ, transapical axis 38μ (median area).

Observed at Sts. WS 481; MS 97.

## Suborder MONORAPHIDINEAE

### Family ACHNANTHACEAE

### Subfamily *ACHNANTHOIDEAE*

1. Cells isobilateral upon apical axis only ... ... ... ... ... ... *Achnanthes*

### Subfamily *COCCONEIOIDEAE*

1. Cells isobilateral upon apical and transapical axis ... ... ... ... *Cocconeis*

### Subfamily *ACHNANTHOIDEAE*

### Genus **Achnanthes** Bory

Bory, 1822 *a*, p. 79

**Achnanthes kerguelensis** Castracane.

Castracane, 1886, p. 41, pl. 20, fig. 15.

Cells often united to form chains. Valves dissimilar. In outline the valves are lanceolate-rhomboidal with apices slightly produced, but obtusely rounded. The upper valve bears a median raphe, the central hyaline space is extended laterally to form a complete stauros. The lower valve possesses a pseudoraphe only, in the apical axis, and no transapical stauros. Both valves are furnished with fine moniliform striae, arranged in parallel transapical lines. Apical axis of cell 36μ; transapical axis 16μ. Type locality, near Kerguelen Island.

A small stipitate epiphytic diatom characteristic of the coastal flora of the Antarctic land-masses. Observed in small numbers only.

Observed at St. WS 481.

## Subfamily *COCCONEIOIDEAE*

### Genus **Cocconeis** Ehrenberg

Ehrenberg, 1838

**Cocconeis antiqua** Tempère et Brun.

Tempère and Brun, 1889 (1890), p. 32, pl. 8, fig. 5.
Cleve, 1895, p. 177.

Cells oval, small, with dissimilar valves. The upper valve has a stout margin, furnished with short radiating lines of puncta; lines varying in length, being composed of from four to ten granules in each line. The central area of the valve surface is covered with puncta somewhat irregularly arranged and is divided by a narrow, fusiform, and almost plain area arranged in the apical axis. The puncta of the central area are separated from those of the marginal lines by a hyaline space. The lower valve bears a narrow hyaline band immediately inside the margin surrounding the broad central area, which is covered with curved moniliform striae arranged on either side of the raphe. Hyaline central area narrow. Apical axis of cell 60–76$\mu$; transapical axis 42–54$\mu$.

Observed at Sts. WS 481; MS 100, 101, 102, 103.

**Cocconeis ceticola** Nelson ex Bennett.

Bennett, 1920, vol. XCI, p. 355.
Hart, 1935, p. 256, pl. 11, figs. 1–4.

Cells solitary, that is, not united to form chains, but found often forming large colonies. The outline of the valves is elliptic-lanceolate, the apical axis of the cell being about twice as much as the diameter. The cells are strongly concavo-convex. The upper valve possesses a straight pseudoraphe which is dilated very slightly in the median area of the valve, forming a small lanceolate hyaline area. Valve surface covered with subradiate striae; margin strongly punctate. The lower valve possesses a strong raphe, somewhat sigmoid. Raphe surrounded by a narrow axial area which dilates towards the centre of the valve to form an oblique stauros which tapers to a fine point as it approaches the valve margin. Valve surface covered with extremely fine striae; margin strongly punctate. One of the most characteristic Antarctic diatoms, and the peculiar structure of the stauros upon the raphe-bearing valve is unique in the genus *Cocconeis*. Apical axis of cell 22–32$\mu$; transapical axis 12–20$\mu$. Type locality: in the skins of *Balaenoptera musculus* and *B. physalus*, South Shetlands.

Hart (1935) has dealt fully with the distribution of this organism in his highly successful account of its occurrence in the cutaneous investment of certain cetaceans, particularly the Blue and Fin whales, *Balaenoptera musculus* and *Balaenoptera physalus*, and more rarely upon the Sei and Sperm whales, *Balaenoptera borealis* and *Physeter catodon*. He was able to show that the infection takes place during the southerly feeding migration and that the strong development of the schooling habit is responsible for its appearance amongst certain classes of whales. Hart was able to show also that the thickness of the diatom film indicated in a rough manner the length of time the whales spent on the feeding grounds before returning to warmer waters to breed, and he obtained confirmation of Bennett's observations (Bennett, 1920, p. 353) that whales with a heavy diatom infection are fatter and altogether in a better condition than those not infected.

**Cocconeis imperatrix** A. Schmidt. (Pl. X, figs. 8, 9.)

A. Schmidt, 1894, pl. 189, figs. 11–15.

Cells broadly oval, often large, valves flat, dissimilar. The upper valve is very ornate. The fine raphe is surrounded by a very narrow hyaline area and the broad central area is furnished with furrows containing two lines of puncta arranged transapically. The lines of puncta are almost parallel, straight in the median portion, curved towards the apices. The furrows are interrupted by a narrow hyaline ridge which follows the line of the margin of the valve a short distance inside it, but they are continued again between it and the valve margin, forming a number of elongated marginal loculi. The lower valve possesses a pseudoraphe which is somewhat fusiform, and the furrows on the valve surface, which are a little less distinct than those on the upper valve, proceed towards the margin of the valve and are not crossed by the hyaline ridge. Apical axis of cell 80–150$\mu$. Type locality, Magellan Straits.

This species is a common littoral diatom in the South Atlantic, and was observed in the Bransfield Strait and in East Cumberland Bay, South Georgia.

Observed at Sts. 552; WS 481; MS 97.

**Cocconeis pinnata** Gregory ex Greville.

Greville, 1859 *a*, p. 79, pl. 6, fig. 1.
*Cocconeis pinnata* var. *plena* M. Peragallo, 1921, p. 53, pl. 2, fig. 4.

Cells small, valves oval, raphe distinct. Valve surface covered with strong moniliform striae. Striae slightly curved about the apices. Axial area narrow, linear to linear-lanceolate. Apical axis of cell 40$\mu$; transapical axis 28$\mu$.

I have united Peragallo's *C. pinnata* var. *plena* with the type. As far as I can ascertain the features upon which Peragallo established the variety are in themselves of no importance and vary considerably from specimen to specimen.

Observed at Sts. 664; WS 481; MS 97.

**Cocconeis scutellum** Ehrenberg.

Ehrenberg, 1838, p. 194, pl. 14, fig. 8.
Hustedt, 1930, p. 191, fig. 267.

Cells small, usually solitary. Valves oval in outline, valve surface flat or nearly so. Valves dissimilar. The one bears a narrow and short, straight raphe surrounded by a narrow axial area, and furnished with radiating lines of small puncta which terminate in a small cluster of puncta a short distance from the valve margin. The punctate portion is surrounded by a narrow but distinct hyaline marginal band. The other bears a narrow pseudoraphe and is furnished with coarser puncta than those upon the raphe-bearing valve, arranged in weakly radiating lines on either side of the narrow axial area.

The puncta are almost square, slightly rounded towards the centre, becoming smaller as they approach the margin where they become clusters of very fine puncta. Apical axis of cell 28–64$\mu$; transapical axis 16–40$\mu$.

A typical neritic diatom, common around the European coasts. It was observed at one station only on the 30th W meridian, at a considerable distance from land, in the company, however, of several other species which are not true inhabitants of the plankton.

Observed at St. 670.

## Suborder BIRAPHIDINEAE

## Family NAVICULACEAE

### Subfamily *NAVICULOIDEAE*

| | | |
|---|---|---|
| 1. | Cells isobilateral upon apical and transapical axis. Valves flat or nearly so, striation moniliform, usually slightly radiate, valve structure simple | *Navicula* |
| 2. | Valve structure laminate | *Trachyneis* |
| 3. | Axile area raised, striae moniliform, transverse, not reaching valve margin, forming lateral hyaline areas | *Scoresbya* |
| 4. | Cells in valve view sigmoid, striation very fine | *Pleurosigma* |

### Subfamily *AMPHIPROROIDEAE*

| | | |
|---|---|---|
| 1. | Cells with alate projections, median line sigmoid, zone complex | *Amphiprora* |
| 2. | Median line straight, zone simple | *Tropidoneis* |

### Subfamily *NAVICULOIDEAE*

### Genus **Navicula** Bory

Bory, 1822 *b*, p. 128

As there have been many conflicting statements in the literature concerning the date of the first publication of the genus *Navicula*, the following note is not without interest. The genus was described first by Bory de Saint Vincent in the *Dictionnaire Classique D'Histoire Naturelle*, vol. II, p. 128, under Bacillariées, p. 127. Bory described the genus and stated that "*Le Vibrio tripunctatus* de Müller est le type de ce genre." Reference was also made to a figure (fig. 3). The plates of vol. XVII of the Dictionnaire were published in fascicules of ten plates, but no indication was given of the dates of publication. Plate 54 bears the illustration referred to in fig. 3. The illustration was very small, and apart from representing a boat-shaped organism it would be impossible to make any specific determination of it. Three species of *Navicula* were illustrated, *N. unipunctata*, *N. bipunctata*, *N. tripunctata*. The epithets referred to the large rounded dots which appeared in the organism. From the position and size of these dots I consider them to represent cell contents and not markings upon the valve surface. Ehrenberg in *Infusionsthierchen* (1838) placed these species as doubtful synonyms under *Navicula gracilis*.

**Navicula astrolabensis** Hendey, sp.nov. (Pl. IX, figs. 14, 15.)

*Valvis* lineari-lanceolatis vel anguste ellipticis; *apicibus* rotundatis, notulis duobus lobatis instructis; *raphe* recta, angusta; *striis* transversis, obliquis, decussatis (*Pleurosigmatis* ad instar), subtilissimis, raphen non attingentibus; *nodulo centrali* parvo, area circulari cincto; *nodulis terminalibus* parvis. *Mensura valvarum* 280 × 30μ.

*Hab.* in aquis marinis "Bransfield Strait", prope insulam "Astrolabe" dictam, in oceano Antarctica.

*Typus* in Herb. Mus. Brit. No. 33963.

This species occurred in small quantities in the material obtained at St. WS 481 where the net touched bottom. It is not a true member of the plankton, but a bottom form. In this it is near *Pleurosigma*, to which it bears a striking resemblance, particularly in the arrangement of the moniliform striae upon the valve surface. Some workers have included such species in the genus *Pleurosigma* despite the fact that the valves do not show the characteristic sigmoid flexure.

Observed at St. WS 481.

**Navicula corymbosa** (Agardh) Cleve.

Cleve, 1895, p. 26.
*Schizonema corymbosum* Agardh, 1824, p. 11.

Cells small, usually united in fine branched mucous tubes. Valves lanceolate in outline, apices very slightly produced, obtuse. Axial and central areas indistinct. Striae very fine, slightly radiate. Connective zone simple, narrow. Chromatophores: several rounded bodies. Apical axis of cell 10–12μ.

Observed near St. 560.

**Navicula lyra** Ehrenberg.

Ehrenberg, 1843, p. 419, pl. 1, fig. 9 *a*.
Kützing, 1844, p. 94, pl. 28, fig. 55.
Cleve, 1895, p. 63.
Mann, 1907, p. 347.

Cells usually large. Valves elliptical with rounded or slightly rostrate apices. Raphe distinct, surrounded by a narrow hyaline axial area which dilates to form a short stauros around the central nodule. The hyaline stauros is continued to produce lyre-shaped sulci which proceed towards the rounded apices of the valve. The valve surface is furnished with fine puncta, with the exception of the sulci. In the narrow areas between the raphe and the sulci the puncta are in straight parallel rows, in the areas between the sulci and the valve margin they are very slightly radiate. Connective zone simple. Apical axis of cell 120–140μ; transapical axis 60μ.

Mann (1907) said "It is plain that this polymorphic form has no hard and fixed boundaries, and that what is to be included, or what not, must always be somewhat a matter of personal preference." One of the most ornate species of the genus *Navicula*, it is found in both fossil and recent material, and has a world-wide distribution. Cleve (1895) gives nineteen varieties and forms of this species, and said of the *Lyratae* "All their characteristics are subject to so much variation that I am unable to distinguish more than a very few well defined forms." The slide collection of F. W. Payne, now in the British Museum (Nat. Hist.), contains what is to my mind the most perfect selection of specimens of *Navicula lyra* it is possible to see. A close study of these most beautiful mounts forces one to the conclusions of Cleve and Mann. I feel that in dealing with this species the multiplication of varieties and forms serves no useful purpose, and that we are called upon to regard the problem from a wider aspect. The species must be regarded as a polyphasic system, expressing itself in space and time.

The species was observed in small numbers at one station only. The specimens closely approximate to the type illustrated by Ehrenberg.

Observed at St. WS 622.

**Navicula subpolaris** Hendey, nom. nov.

*Navicula cristata*, Peragallo, M. 1921, p. 56, pl. 2, fig. 11.

Cells usually solitary. Valves linear-lanceolate in outline, angles acute. Valve surface convex, possessing a prominent median raphe and a small and almost circular hyaline central area; polar and central nodules small. Valve surface furnished with strong transverse striation. Upon either side of the raphe, between it and the margin of the valve, is a fine line which extends to the apices of the cell.

A small characteristic Antarctic diatom observed in small numbers in water obtained from melted ice. The new name given above is necessary because *Navicula cristata* is preoccupied (*Navicula cristata* Ehrenberg, 1854).

Observed near St. 560.

**Navicula membranacea** Cleve. (Pl. XI, fig. 4.)

Cleve, 1897 *a*, p. 24, pl. 2, figs. 25–28.
Lebour, 1930, p. 206, fig. 169.

Cells united to form short, thick, straight chains. Cells in valve view narrow, linear, with weak median inflation; apices pointed. Connective zone deep, giving the cell a rectangular girdle view; zone finely striate, striae difficult to see. Chromatophores: two undulating ribbon-like bodies, arranged in the apical axis of the cell. Apical axis of cell 60–84$\mu$; pervalvar axis 30–40$\mu$.

This weakly siliceous form, is common in the plankton of temperate and subtropical seas. It was observed, but not in great numbers, to the south of Africa.

Observed at St. 1373.

**Navicula Schuettii** Van Heurck.

Van Heurck, 1909, p. 13, pl. 1, fig. 10.

Valve broadly lanceolate, subrhomboidal, with subconical obtuse apices. Raphe strong, straight; polar nodules prominent but small; central nodules small, surrounded by a small rounded or oval central area; axial area narrow. Valve surface covered with a fine moniliform striation arranged somewhat radially. Striae of the median portion of the valve more distant than those which occupy the remainder of the valve surface.

Connective zone simple. Chromatophores: several small plates. Apical axis of cell 130–160$\mu$; transapical axis 40–45$\mu$.

Observed at St. WS 481.

### Genus **Trachyneis** Cleve

Cleve, 1894

**Trachyneis aspera** (Ehrenberg) Cleve. (Pl. X, fig. 10.)

Cleve, 1894, p. 191.
*Navicula aspera* (Ehrenberg) Donkin, 1871–3, p. 62.

Cells usually solitary. Valves laminate, weakly elliptic to linear-lanceolate. Apices rounded. Raphe very distinct, surrounded by a narrow axial area, sometimes having the appearance of being weakly sigmoid. Central area dilated to form a stauros which becomes wider as it moves towards the valve margin, but terminates short of the margin, not joining it. Valve surface furnished with bold striae which are slightly radiate throughout. Connective zone simple. Apical axis of cell 180–220$\mu$; transapical axis 40$\mu$.

Observed at St. WS 481.

### **Scoresbya** Hendey, gen.nov.

*Frustula* libera, rarissime subseriato-coalescentia; *valvae* lanceolatae vel lanceolato-lineares, exacte symmetricae, *nodulis* centrali terminalibusque donatae; *superficies* striata, *striae* moniliformes partem mediam occupantes, *segmentis* marginalibus exceptis.

This genus is named after the R.R.S. 'William Scoresby' in which the operations in the Bransfield Strait were carried out during 1929.

### **Scoresbya Kempii** Hendey, spec.nov. (Pl. IX, figs. 16, 17.)

*Valvis* lineari-ellipticis, apicibus acutis; *raphe* conspicua, margine prominente; *nodulo centrali* distincto, lentiformi; *nodulis terminalibus* minutissimis; *striis* transversis, moniliformibus, parallelis, subtilissimis, stauro parvo excepto.

*Mensura valvarum* 240 × 30$\mu$.

*Hab.* in aquis marinis "Bransfield Strait" prope insulam "Astrolabe" dictam, in mari Antarctica.

Typus in Herb. Mus. Brit. No. 33965.

This species is named in honour of Dr Stanley Kemp, F.R.S., until lately Director of Research to the Discovery Committee.

This species was extremely rare. Seven specimens only were found after much searching. The structure of the cell was most characteristic and from the examination of the few specimens available, it is likely that the transverse section of the cell would present a rectangular appearance, the opposing raphes occupying angular positions. In the first instance I was tempted to place the species in the genus *Navicula* but soon became aware that none of the subgeneric groups of either Cleve or Van Heurck would accommodate it. The relatively large hyaline areas along the margins of the valves, which are separated from the central striate portion by a line, present some entirely new characters in the valve structure of the Naviculaceae. Unfortunately the photosynthetic elements were absent from all of the specimens observed, so no knowledge was obtained of the cell contents.

Observed at St. WS 481.

### Genus Pleurosigma Wm Smith

Wm Smith, 1852

The genus *Pleurosigma* was reviewed by Wm Smith in the first volume of his *Synopsis of British Diatomaceae* (1853), p. 61, twenty-six species were described. In vol. II of the same work (1856, p. 97) Smith explained that "the alliterative blunder in the name *Gyrosigma* (*Gyrosigma* Hassall, 1845) must be my excuse for not adopting it as the designation of this division of the *Naviculaceae* an excuse whose validity I find thus admitted by M. de Brébisson in the brochure above quoted" [Brébisson, *Diatomées de Cherbourg* (1854), p. 255].

As *Pleurosigma* was synonymous with *Gyrosigma* and the only excuse put forward by Smith in support of his name was that he objected to the construction of the earlier one, technically speaking, the name *Pleurosigma* was illegitimate and should be rejected in favour of *Gyrosigma* Hassall.

The genus *Gyrosigma* was established by Hassall in his *History of the British Freshwater Algae* (1845, p. 435); one species only was described. A footnote which appeared upon the same page as the generic description informs us that Hassall's reason for creating the genus *Gyrosigma* was that *his* aesthetic taste was upset also by the earlier name used for that group of organisms namely *Sigmatella*. Hassall said "*Sigmatella* of Kützing, the construction of which term is somewhat objectionable, is synonymous with *Gyrosigma*." Technically speaking, the same rule takes effect as in the case of *Pleurosigma*, that is, *Gyrosigma* should be rejected upon the grounds that it is illegitimate.

The matter becomes more complicated if pursued further. The genus *Sigmatella* of Kützing was validly published in 1833 (1833*a*); one species only was described, namely *Sigmatella Nitzschii*, which was based upon *Bacillaria sigmoidea* of Nitzsch. The same species, *Bacillaria sigmoidea* Nitzsch, was taken by Hassall and used for the type of the genus *Nitzschia* (Hassall, 1845, p. 435) under the name *Nitzschia elongata*. The position is that two genera have been established upon one and the same type-species, and by virtue of priority Kützing's *Sigmatella* should be used to designate that group of organisms now known as *Nitzschia*. If the name *Nitzschia* is preferred it must be conserved.

The position of the name *Gyrosigma*, however, is not quite so clear. It is possible that a typographical error occurred on p. 435 of Hassall's book, and that the objection he made to the construction of the name *Sigmatella* was really in support of his genus *Nitzschia* which also appeared upon the same page, and was not meant to refer to *Gyrosigma*, or, what is far more likely, Hassall intended *Gyrosigma* to designate a section of *Sigmatella* of a later publication, that is, not *Sigmatella* Kützing (1833*a*) but *Sigmatella* Kützing in some other place. This suggestion gains support by the fact that

Kützing himself used *Sigmatella* as a subgenus of *Frustulia*, in his *Synopsis Diatomearum* (1833*b*) and described a number of organisms under that name which undoubtedly were not congeneric; for instance, *Frustulia Nitzschii*, illustrated in pl. 14, fig. 33*a*, *b*, is what is known to-day as a *Nitzschia*, and *Frustulia attenuata* in pl. 14, fig. 35 *a*, *b*, is a *Pleurosigma* or *Gyrosigma*. It is most likely that it was to this publication (Kützing, 1833*b*) of *Sigmatella* that Hassall referred when he said that *Gyrosigma* and *Sigmatella* were synonymous, meaning that the organism illustrated on pl. 14, fig. 35 *a*, *b*, was synonymous with *Gyrosigma*, and not the whole of the genus *Sigmatella* as described in 1833*a*. However, Hassall gives no direct indication to which mention of *Sigmatella* Kützing he referred, and, strictly speaking, it is very doubtful whether such taxonomic considerations can be allowed to affect the position of the names.

In such an atmosphere of doubt I have decided to use the generic name *Pleurosigma* in the sense that Wm Smith used it in 1853. The name *Gyrosigma* has been used by Cleve (1894–5), Gran (1905), Lebour (1930) and Hustedt (1930). Hustedt followed Cleve and used the name in a special sense: *Gyrosigma* was used to designate those forms in which the longitudinal striations were in the apical axis of the cell and crossed the transverse striations at right angles, while *Pleurosigma* was used to designate those forms in which the striations in the apical axis were crossed by oblique striations. Personally I do not think that the differences involved warrant generic distinction.

### Pleurosigma directum Grunow.

Cleve and Grunow (1880), p. 53.
Karsten, 1905, p. 127, pl. 18, fig. 5.

Cells solitary. Valves flat or nearly so, rhombic-lanceolate to elliptic-lanceolate in outline. Raphe distinct, only very slightly sigmoid, central knot very small. Striation consisting of two systems of lines of faint puncta which cross at an angle of about 60°. Chromatophores: two anastomosing bands; nucleus large, central. Apical axis of cell 180–270$\mu$; transapical axis 44$\mu$.

This characteristic species is seldom found in large numbers, but has a wide distribution in the waters of both the north and south polar seas.

Observed at St. 428, 437, 478.

### Pleurosigma directum-secundum Karsten.

Karsten, 1906, p. 175, pl. 34, fig. 6.

This species is accepted only with great diffidence. It differs in few respects from *Pleurosigma directum* Grunow and was found at one station only. The most important difference between it and Grunow's species is in the form of the chromatophores. In Karsten's species they take the form of numerous short vermiform bodies, while in the other they consist of two irregular bands. Only a few isolated specimens were observed, and I strongly suspect that the polychromatophoric specimens were a degenerate state of *Pleurosigma directum*.

Observed at St. 438.

**Pleurosigma Smithianum Castracane**

Castracane, 1886, p. 38, pl. 28, fig. 6.

Valves strongly sigmoid, somewhat broad, apices acute. Raphe strong, very prominent, following closely, and in some cases almost concurrent with the dorsal flexures of the valve margin. Central nodule small, surrounded with a small oval central area. Striation very faint, consisting of transapical lines at right angles to the polar axis of the cell. Apical axis of cell 140$\mu$.

Castracane's illustration does not show the striation, nor is any mention made of it in his description; but from herbarium specimens I have examined, which came from the same locality as Castracane's type, I was able to satisfy myself that specimens corresponding to the shape and characters of Castracane's species obtained from the same locality, were furnished with striation at right angles to the polar axis of the valve, and not oblique striation. Consequently I have used Castracane's name to describe the specimens from the Bransfield Strait.

Observed at St. WS 481.

## Subfamily *AMPHIPROROIDEAE*

### Genus **Amphiprora** Ehrenberg

Ehrenberg, 1843

**Amphiprora Kjellmanii Cleve.**

Cleve and Grunow, 1880, p. 15, pl. 4, fig. 83.
Meunier, 1910, p. 291, pl. 32, figs. 4, 6, 7.

Cells large, solitary, tortuous about the valvar axis. Valves elliptic-lanceolate, apices rounded, with a prominent keel. Valves furnished with wing-like projections. Alae sigmoid, striate, striae well marked. Connective zone complex, consisting of a number of folds. Apical axis of cell 130$\mu$; transapical axis 40$\mu$. Type locality, Kara Sea.

This species is found, but never in great numbers, in the Arctic Seas, and has not been reported previously from the Antarctic. A few isolated specimens were observed off South Africa.

Observed at St. 440.

**Amphiprora Oestrupii Van Heurck.**

Van Heurck, 1909, p. 15, pl. 1, fig. 22.

Cells solitary, oblong in outline with a slight constriction close to the central nodule; angles rounded. Median hyaline area extended to the connective zone. Alae well developed, transversely striate; striae parallel in the median area, but curved towards the apices of the cell. Connective zone composed of numerous plicae. Apical axis of cell 160$\mu$.

This species was observed only in small numbers from water obtained from melted ice.

Observed near St. 560.

## Genus Tropidoneis Cleve

Cleve, 1891

**Tropidoneis antarctica** (Grunow) Cleve.

Cleve, 1894, p. 24.
Karsten, 1905, p. 128, pl. 18, fig. 7.

Cells large, somewhat weakly siliceous. Valves elliptical in outline, not furnished with wings. Median line straight, very thin, dilated to form a small central area in the shape of a narrow stauros. Valve furnished with very fine transverse and longitudinal striae. The transverse striae are a little more prominent than the longitudinal ones. Connective zone simple, cell rectangular in girdle view. Chromatophores: two plates. Apical axis of cell 100–150μ.

Probably oceanic.

Observed at Sts. 302, 452, 453, 463, 666.

**Tropidoneis belgicae** (H. van Heurck) Heiden et Kolbe.

Heiden and Kolbe, 1928, p. 655, pl. 4, fig. 98.
*Amphiprora belgicae* H. van Heurck, 1909, p. 14, pl. 1, fig. 15.

Cells weakly siliceous. Valves convex, outline undulate, constricted slightly at the middle, apices broadly rounded, slightly capitate. Raphe very fine, straight, polar nodules distinct, central nodules less distinct. Valve surface furnished with very fine striation somewhat divergent at the apices, but transverse throughout the greater part of the valve surface. Connective zone strongly developed, complex. Apical axis of cell 80μ, transapical axis 20μ.

This characteristic form was observed but only in small numbers from water obtained from melted ice.

Observed near St. 560.

**Tropidoneis proteus** Karsten.

Karsten, 1907, p. 398, pl. 47, fig. 1.

Cells solitary, valves elliptic-lanceolate in outline, apices acute. Valve surface undulatory. Central knot rudimentary, raphe straight, faint, usually accompanied by two parallel lines. Valve covered with very fine striation. Cells in girdle view exhibit a certain amount of characteristic torsion, connective zone simple. Chromatophores: numerous thin bands, or vermiform bodies which radiate from a prominent central nucleus. Apical axis of cell 150–170μ; transapical axis 40–50μ.

This rather weakly siliceous form occurred but rarely at one station to the south of Africa. It is probably neritic.

Observed at St. 440.

## Family CYMBELLACEAE

### Subfamily *CYMBELLOIDEAE*

1. Pervalvar axis slightly curved, zone simple ... ... ... ... ... ... *Cymbella*
2. Pervalvar axis strongly curved, zone usually complex ... ... ... ... ... *Amphora*

### Genus **Amphora** Ehrenberg

**Amphora Peragallorum** Van Heurck.

Van Heurck, 1909, p. 7, pl. 1, fig. 2.

Valves elongated, weakly cymbiform, with very obtuse extremities, slightly capitate. Dorsal margin weakly arcuate, ventral margin almost straight. Raphe very close to and almost parallel with the ventral margin. Raphe very prominent, straight. Valve surface furnished with robust striation, striae short, confined to the dorsal half of the valve surface, the ventral half being quite hyaline. Apical axis of cell 60–110$\mu$.

Observed at St. WS 481.

## Family BACILLARIACEAE

### Subfamily *NITZSCHIOIDEAE*

1. Cells linear, with marginal keel, valves finely striate ... ... ... ... ... *Nitzschia*
2. Cells naviculoid, raphe eccentric, valves finely striate ... ... ... ... ... *Chuniella*

### Genus **Nitzschia** Hassall

Hassall, 1845

It has been explained under *Pleurosigma* that *Nitzschia* Hassall (1845) is an absolute synonym of *Sigmatella* Kützing (1833 *a*), as both genera are based upon *Bacillaria sigmoidea* Nitzsch. However the name *Nitzschia* is used here, until it is legally conserved, in the sense that most modern taxonomists have used it; that is, in the sense that Wm Smith used it in his *Synopsis of British Diatomaceae* (1853); taking *Nitzschia sigmoidea* Wm Smith based on *Sigmatella Nitzschii* Kützing, which was *Bacillaria sigmoidea* Nitzsch, as the type of the genus.

**Nitzschia Barbieri** M. Peragallo.

Peragallo, M., 1921, p. 66.
*Nitzschia Ostenfeldii*, var. *minor* Van Heurck, 1909, p. 22, pl. 3, fig. 177.

Cells usually solitary. Valves linear-oblong with margins parallel, and subobtuse apices. Valve surface furnished with bold transverse striae, slightly curved towards the apices, but straight in the median area of the valve. Each striation is terminated by a strong carinal dot. Connective zone simple. Apical axis of cell 80–150$\mu$.

This species was described first by H. van Heurck (1909) as a variety of *Nitzschia Ostenfeldii*, but Peragallo pointed out the essential differences between them, and raised van Heurck's variety to specific status. In this I agree with Peragallo.

Observed near St. 560.

**Nitzschia closterium** (Ehrenberg) Wm Smith. (Pl. XI, fig. 1.)

Smith, 1853, p. 42, pl. 15, fig. 120.
Lebour, 1930, p. 212, fig. 176.
*Ceratoneis closterium* Ehrenberg, 1840*a*, p. 144.

Cells solitary, not united to form chains, but often found in enormous masses. The shape of the cell may vary considerably, but generally the main or central portion is weakly oblong with the ends tapering off gently to form the long hair-like apices, or shortly crescentic, or fusiform, with the characteristic attenuate apices. The apices vary in length considerably, and one is usually bent slightly. Chromatophores: two flattened bodies. Apical axis of cell up to 80μ.

A neritic species, widely distributed around the Atlantic coasts of European countries. It was observed occasionally around South Georgia and the South Sandwich Group.

Observed at Sts. 304; WS 542, 543.

**Nitzschia pelagica** Karsten.

Karsten, 1905, p. 129, pl. 18, fig. 10.

Cells large, elliptic-lanceolate, apices acute. Raphe central, distinct. Striations very fine, uniform. Connective zone deep, simple. Chromatophores: numerous vermiform bodies, nucleus central. Apical axis of cell 70–270μ; transapical axis 22–40μ.

A large form of *Nitzschia*, often found in considerable numbers, most probably neritic. It was observed frequently around South Georgia.

Observed at Sts. 475, 477, 479, 508; WS 550.

**Nitzschia seriata** Cleve.

Cleve, 1883, p. 478, pl. 38, fig. 75.
Gran, 1905, p. 129, fig. 174.
Lebour, 1930, p. 213, fig. 178.

Cells narrow, linear-lanceolate, apices acute; united to form short, stiff chains, by the cells lying together almost point to point. Markings very difficult to see. Chromatophores: numerous small granules. Apical axis of cell 40–70μ; transapical axis 6–8μ.

A small neritic species often found in enormous numbers; very common around South Georgia, Drake Strait, and in the Bellingshausen Sea.

Observed at Sts. 260, 302, 303, 304, 378–385, 388, 434, 463, 475, 478, 479, 480, 482, 502, 503, 508, 570, 575, 576, 577, 580, 670; WS 469, 474, 542, 543, 545, 547, 548, 549, 593, 601, 602, 700, 701, 703, 705, 706, 709, 710.

### Genus Chuniella Karsten

Karsten, 1905

**Chuniella oceanica** (Karsten) Hendey, comb. nov.

*Navicula oceanica* Karsten, 1905, p. 126, pl. 18, fig. 4.

Cells large, usually solitary. Valves somewhat broadly lanceolate in outline with subacute apices. Raphe rather prominent, eccentric, depressed slightly in the middle of the valve. Connective zone simple. Chromatophores: numerous cocciform bodies, conglomerated near the middle of the cell. Apical axis of cell 240$\mu$; transapical axis 30$\mu$.

Several isolated specimens which corresponded with Karsten's illustration and description were observed around South Georgia. The cells were weakly siliceous and did not occur in sufficient numbers to allow careful examination to be made, but an examination of the small number available showed quite clearly that this form did not belong to the genus *Navicula*. I have placed it in the genus *Chuniella* of Karsten, a genus which is intermediate between *Navicula* and *Nitzschia*, because of the eccentricity of the raphe, the simplicity of the connective zone, and because it approximates in general appearance to the type of that rather ill-defined genus.

Observed at Sts. 384, 475, 478, 481, 505, 1356, 1358.

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# PLATE VI

Fig. 1. *Dactyliosolen antarcticus* Castracane; type phase, girdle view.

Figs. 2, 3. *Dactyliosolen antarcticus* Castracane; "*laevis*" phase, girdle view.

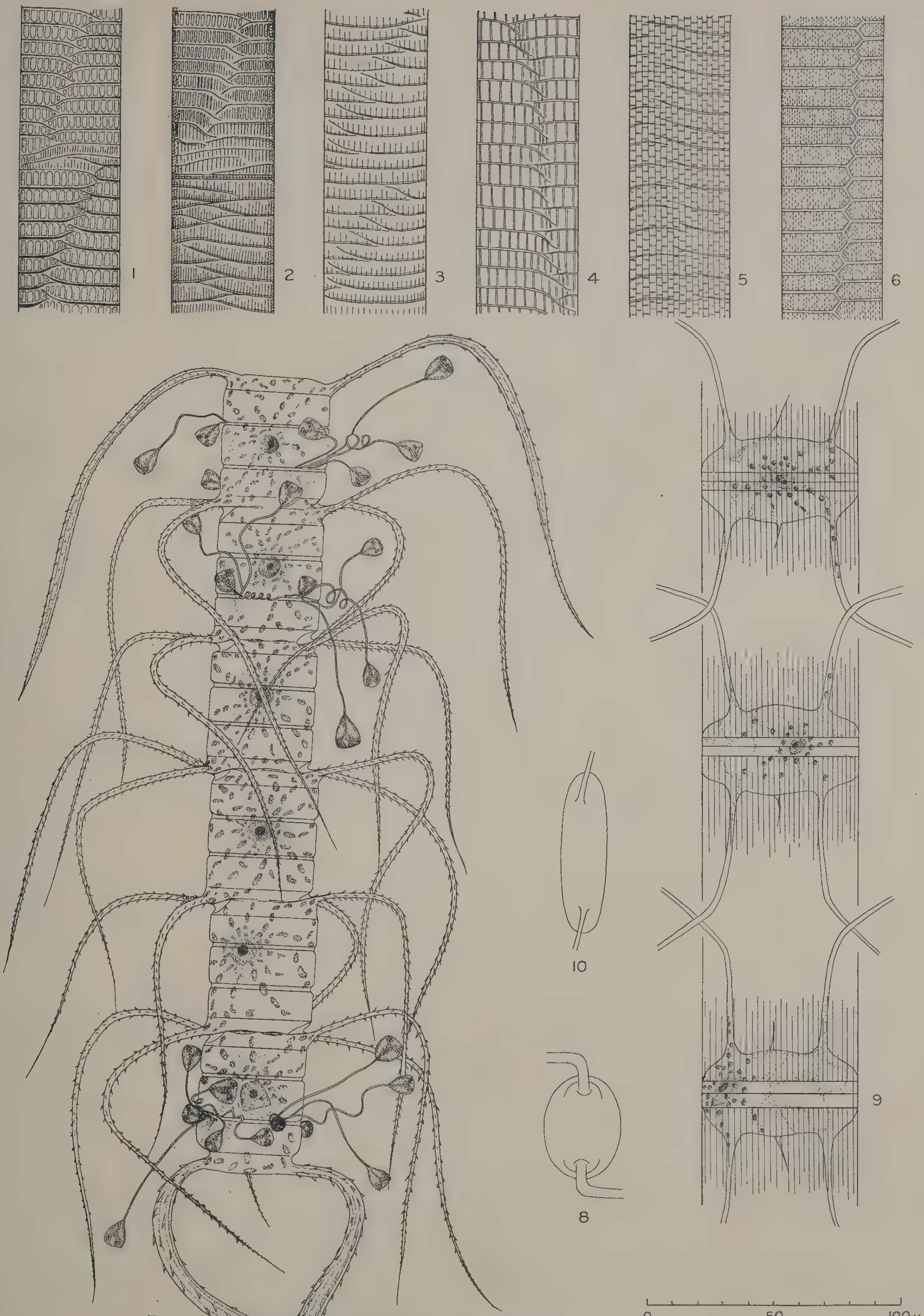
Figs. 4, 5, 6. *Dactyliosolen mediterraneus* Peragallo; girdle view.

Fig. 7. *Chaetoceros coarctatum* Lauder, parasitized by *Vorticella oceanica* Zach. Cells in chain formation, girdle view, showing protoplasmic contents.

Fig. 8. *Chaetoceros coarctatum* Lauder; cell in valve view.

Fig. 9. *Chaetoceros dichaeta* Ehrenberg; cells in chain formation, girdle view.

Fig. 10. *Chaetoceros dichaeta* Ehrenberg; cell in valve view.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# PLATE VII

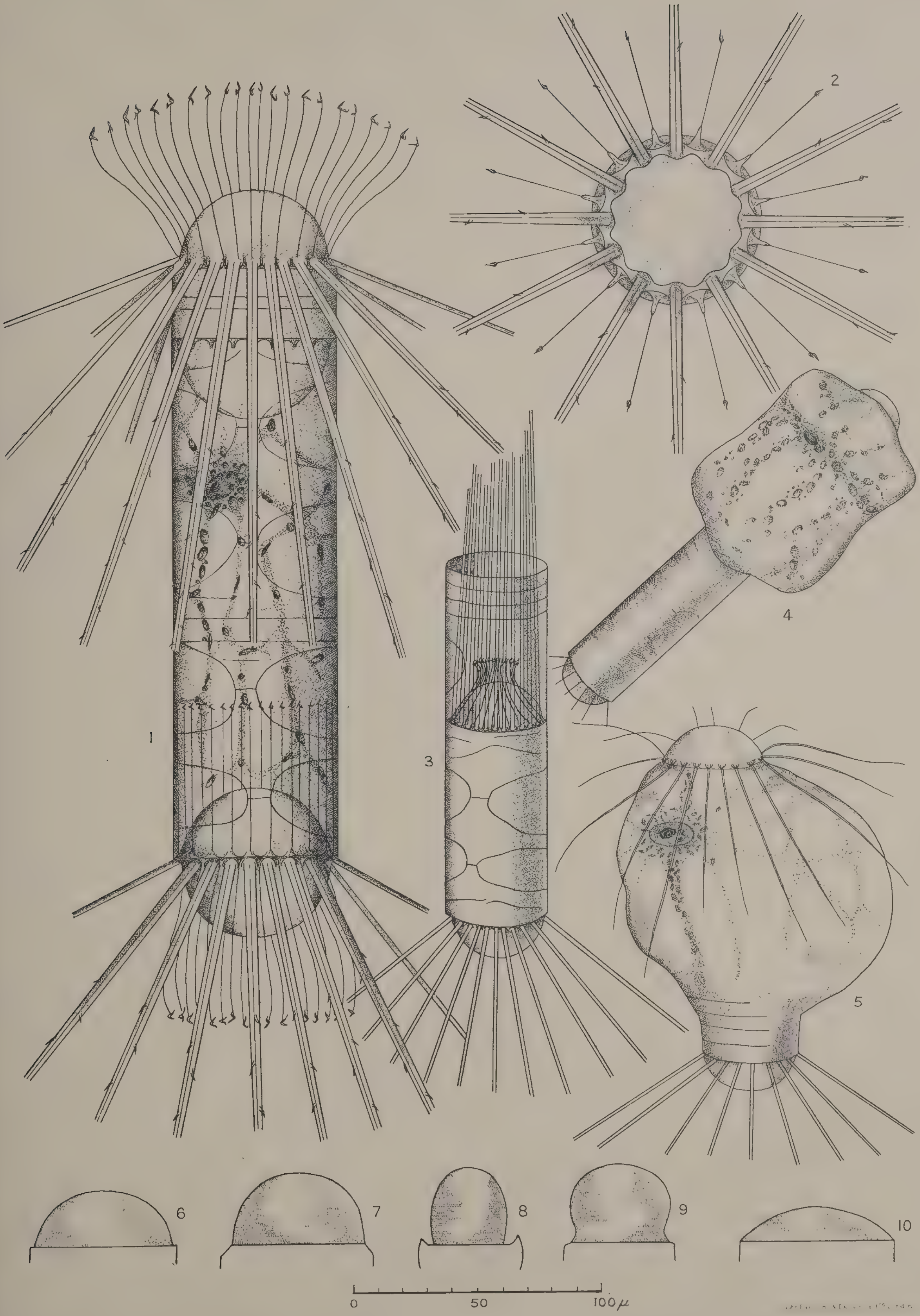
Fig. 1. *Corethron criophilum* Castracane; "*hystrix*" phase, cell in girdle view showing protoplasmic contents, and the imbricate scale-like markings on the connective zone.

Fig. 2. *Corethron criophilum* Castracane; valve view.

Fig. 3. *Corethron criophilum* Castracane; small daughter cell within parent girdle.

Figs. 4, 5. *Corethron criophilum* Castracane; auxospores.

Figs. 6, 7, 8, 9, 10. *Corethron criophilum* Castracane; cell ends, showing variation in convexity.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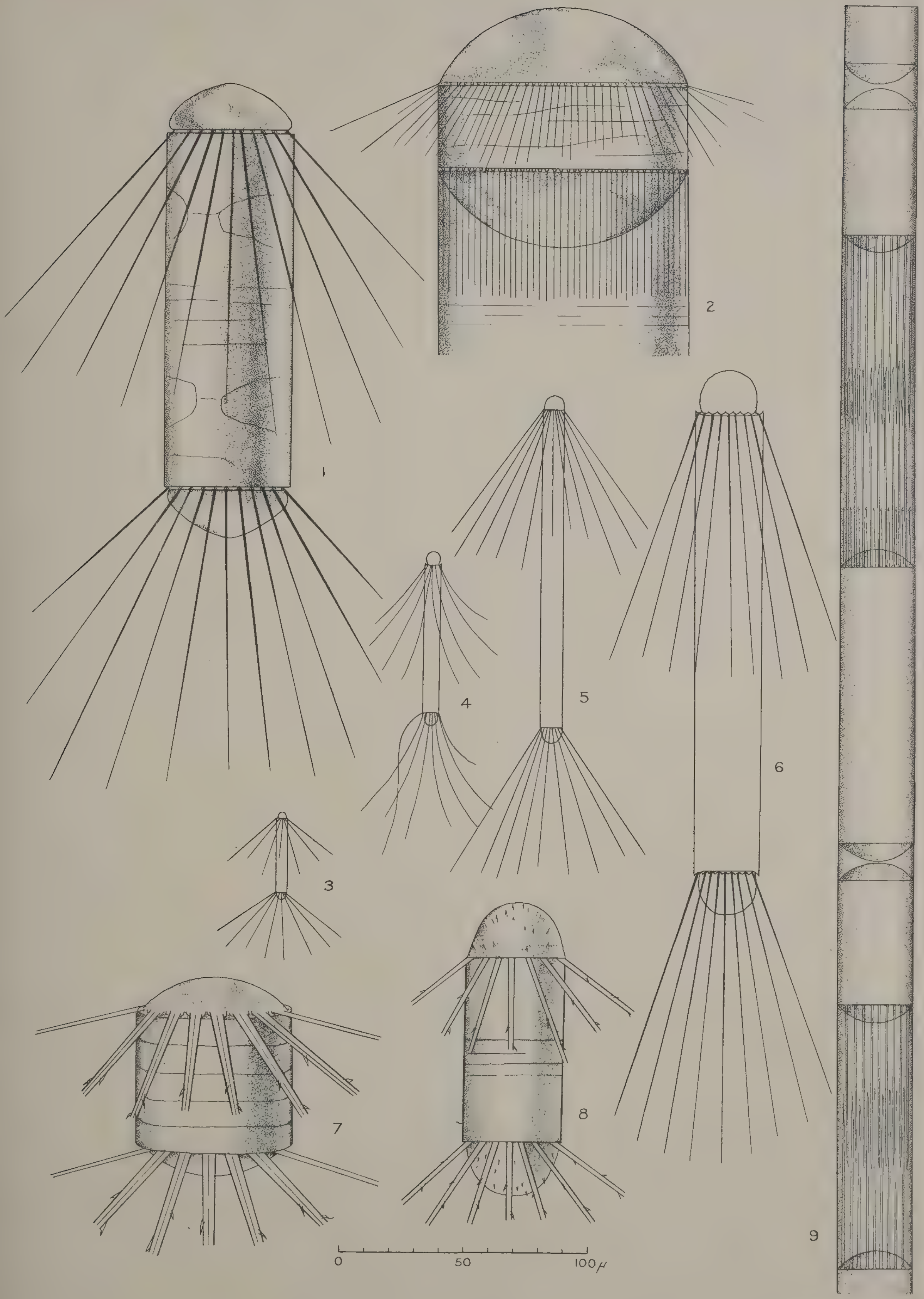
DIATOMS

# PLATE VIII

Fig. 1. *Corethron criophilum* Castracane, "*hystrix*" phase.
Fig. 2. "*pelagicum*" phase.
Figs. 3, 4, 5, 6. "*criophilum*" or type phase.
Figs. 7, 8. "*hispidum*" phase.
Fig. 9. "*inerme*" phase.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# PLATE IX

Fig. 1. *Biddulphia astrolabensis* Hendey; valve view.

Fig. 2. *Biddulphia astrolabensis* Hendey; girdle view.

Fig. 3. *Biddulphia astrolabensis* Hendey; fragment of valve.

Figs. 4, 5, 6, 7. *Anaulus ellipticus* Hendey; cells in girdle view.

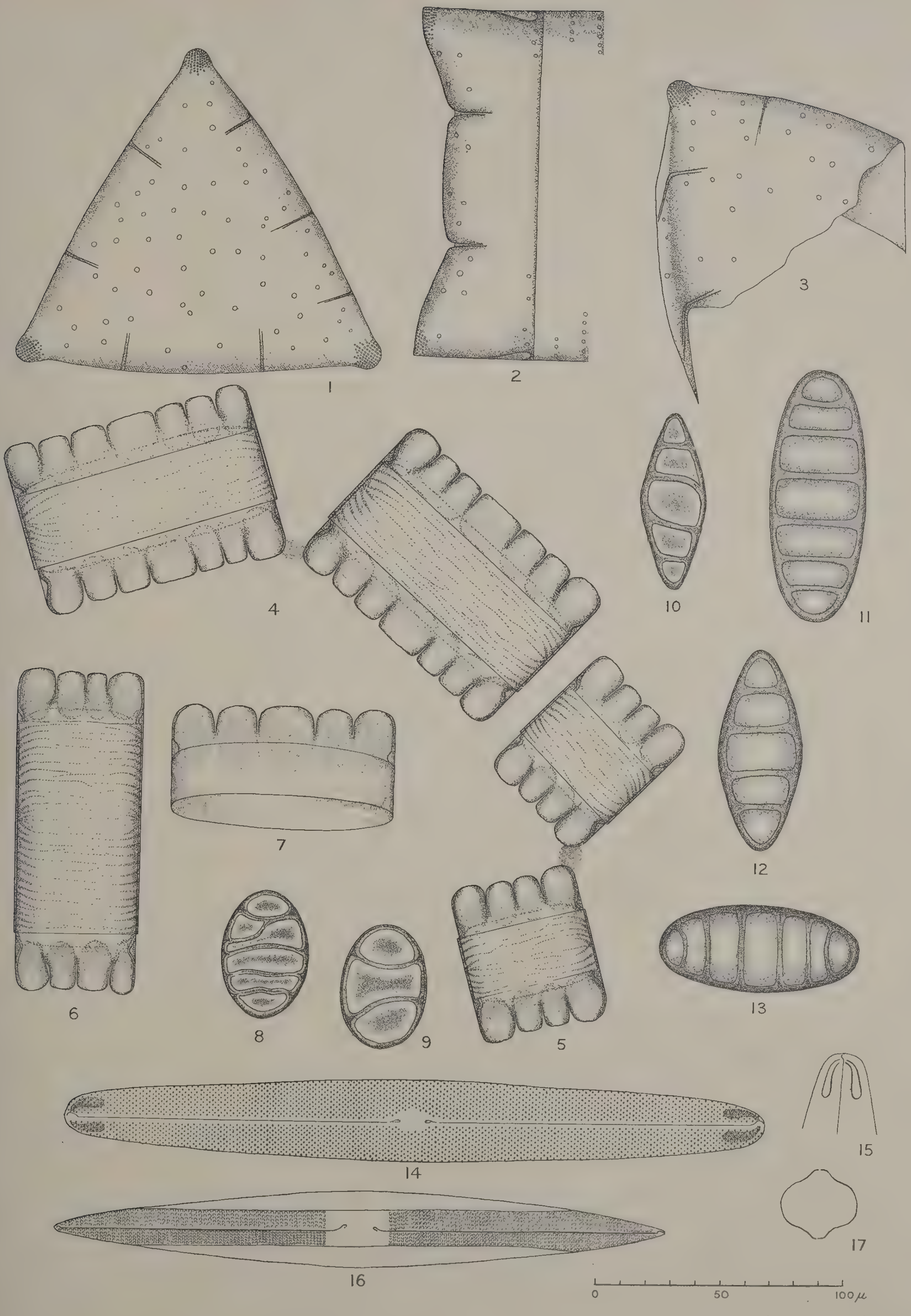
Figs. 8, 9, 10, 11, 12, 13. *Anaulus ellipticus* Hendey; cells in valve view.

Fig. 14. *Navicula astrolabensis* Hendey; valve view.

Fig. 15. *Navicula astrolabensis* Hendey; end of cell in valve view showing lobular markings.

Fig. 16. *Scoresbya Kempii* Hendey; cell in valve view.

Fig. 17. *Scoresbya Kempii* Hendey; transapical section of cell.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DIATOMS

# PLATE X

Fig. 1. *Trigonium arcticum* (Brightwell) Cleve; cell in girdle view.

Fig. 2. *Triceratium favus* Ehrenberg; cell in girdle view.

Fig. 3. *Triceratium favus* Ehrenberg; cell in valve view.

Fig. 4. *Biddulphia striata* Karsten; cells in chain formation, girdle view, showing protoplasmic contents.

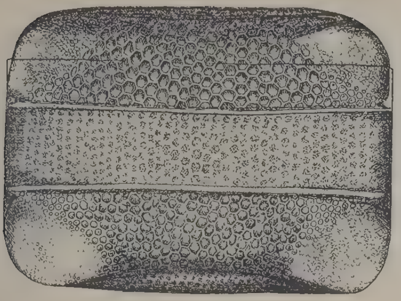
Fig. 5. *Biddulphia striata* Karsten; cell in valve view.

Figs. 6, 7. *Charcotia bifrons* (Castracane) Peragallo.

Fig. 8. *Cocconeis imperatrix* Schmidt; valve view showing pseudoraphe.

Fig. 9. *Cocconeis imperatrix* Schmidt; valve view showing true raphe.

Fig. 10. *Trachyneis aspera* (Ehrenberg) Cleve; valve view.



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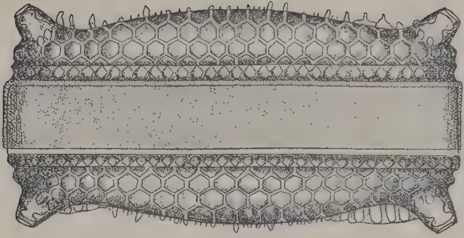

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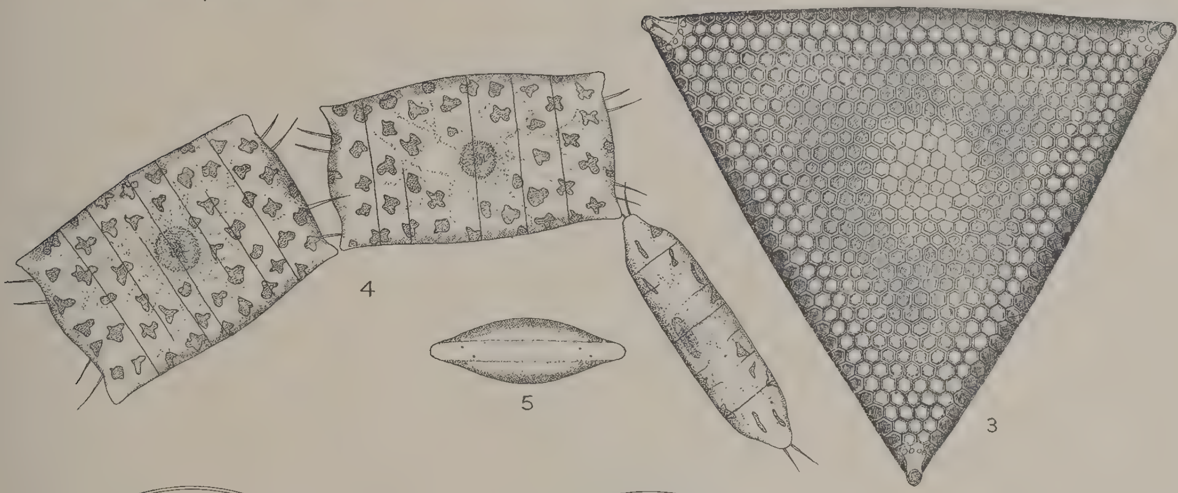

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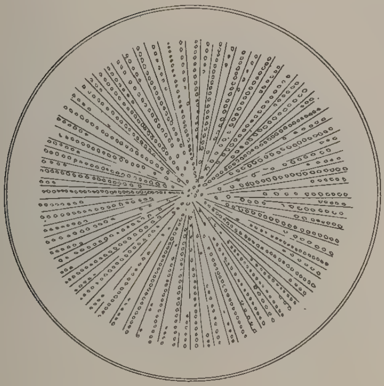

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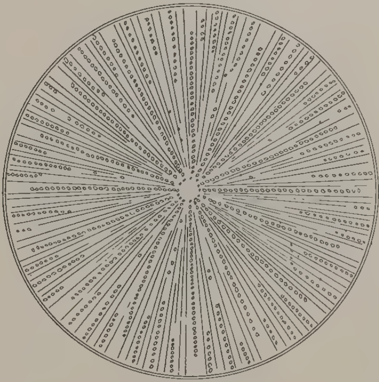

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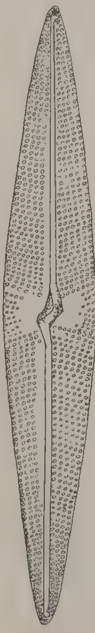

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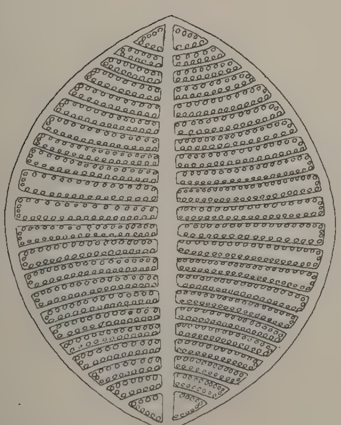

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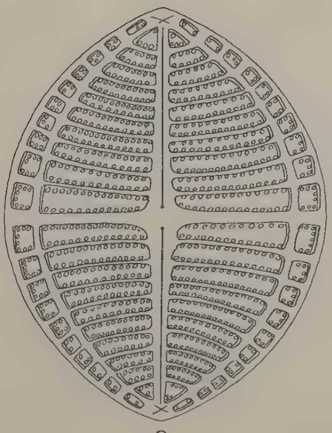

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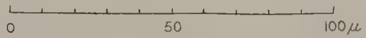

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# PLATE XI

Fig. 1. *Nitzschia closterium* Wm Smith; cells in valve view.

Fig. 2. *Rhabdonema adriaticum* Kützing; single cell in girdle view, showing internal septa.

Fig. 3. *Asterionella japonica* Gran; cells in a spiral colony, girdle view, showing protoplasmic contents.

Fig. 4. *Navicula membranacea* Cleve; cells in ribbon formation, girdle view, showing protoplasmic contents; note undulating ribbon-like chromatophores.

Fig. 5. *Guinardia flaccida* (Castracane) Peragallo; cell in girdle view, showing stellate chromatophores and annular structure of the connective zone.

Fig. 6. *Leptocylindrus danicus* Cleve; cells in girdle view, showing protoplasmic contents, and intercalary bands of the connective zone.

Fig. 7. *Rhizosolenia Stolterfothii* Peragallo; cells in curved chains, girdle view, showing protoplasmic contents and intercalary bands of the connective zone.

Fig. 8. Ditto. A large form from warm water.

Fig. 9. *Thalassiosira decipiens* Jörgensen; cells united by a central mucous thread, in girdle view, showing contents.

Fig. 10. *Thalassiosira gravida* Cleve; cells in girdle view united by central mucous thread.

Fig. 11. *Thalassiosira condensata* Cleve; cells in girdle view united by central thread, showing protoplasmic contents and annular structure of connective zone.

Fig. 12. Ditto. Cell in valve view.

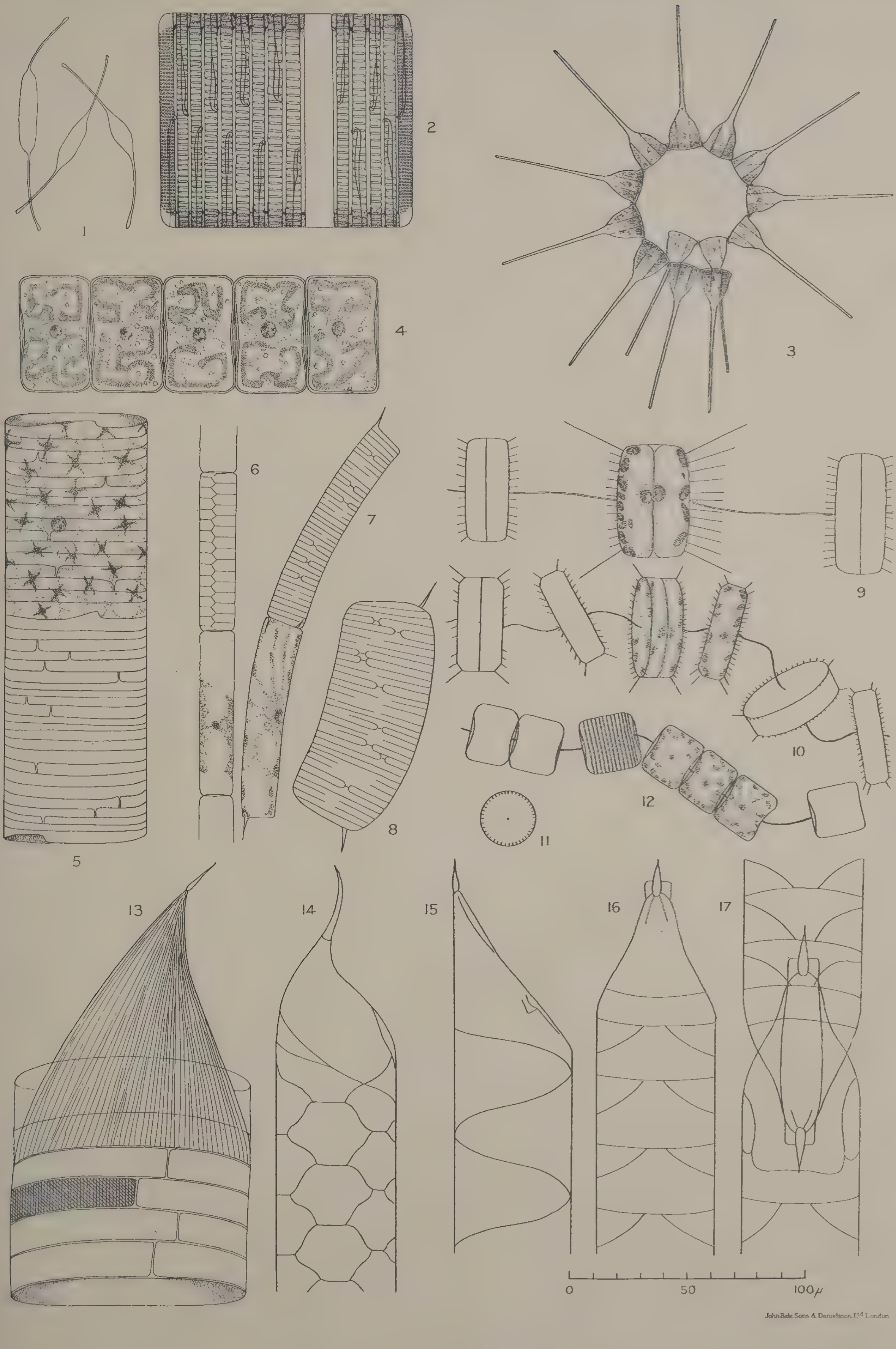
Fig. 13. *Rhizosolenia robusta* Norman; cell end, showing striate conical valve, and the finely areolate annular structure of the connective zone.

Fig. 14. *Rhizosolenia calcar-avis* Schultze; cell end, showing curved apex of valve and intercalary scale-like connective zone.

Fig. 15. *Rhizosolenia styliformis* Brightwell; cell end, lateral view.

Fig. 16. Ditto. Cell end, dorsal view.

Fig. 17. Ditto. Dorsiventral view of juncture of two cell ends.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DIATOMS

# PLATE XII

Fig. 1. *Gossleriella tropica* Schütt; cell in valve view showing protoplasmic contents, and the double corona of stout spines at the periphery.

Fig. 2. *Biddulphia regia* (Schultze) Ostenfeld cell in valve view.

Fig. 3. Ditto. Cell in girdle view, showing numerous cocciform chromatophores.

Fig. 4. *Ditylum sol* De Toni; cell in girdle view.

Fig. 5. *Ditylum Brightwellii* Grunow; cell in girdle view showing protoplasmic contents and intercalary scale-like marking upon the connective zone. A temperate form.

Fig. 6. Ditto. Cell in girdle view showing protoplasmic contents. A warm-water form.

Fig. 7. *Eucampia zoodiacus* Ehrenberg; cells in ribbon formation, girdle view.

Fig. 8. *Climacodium Frauenfeldianum* Grunow; cells in ribbon formation, girdle view.

Fig. 9. *Biddulphia mobiliensis* Grunow; cell in girdle view, showing protoplasmic contents.

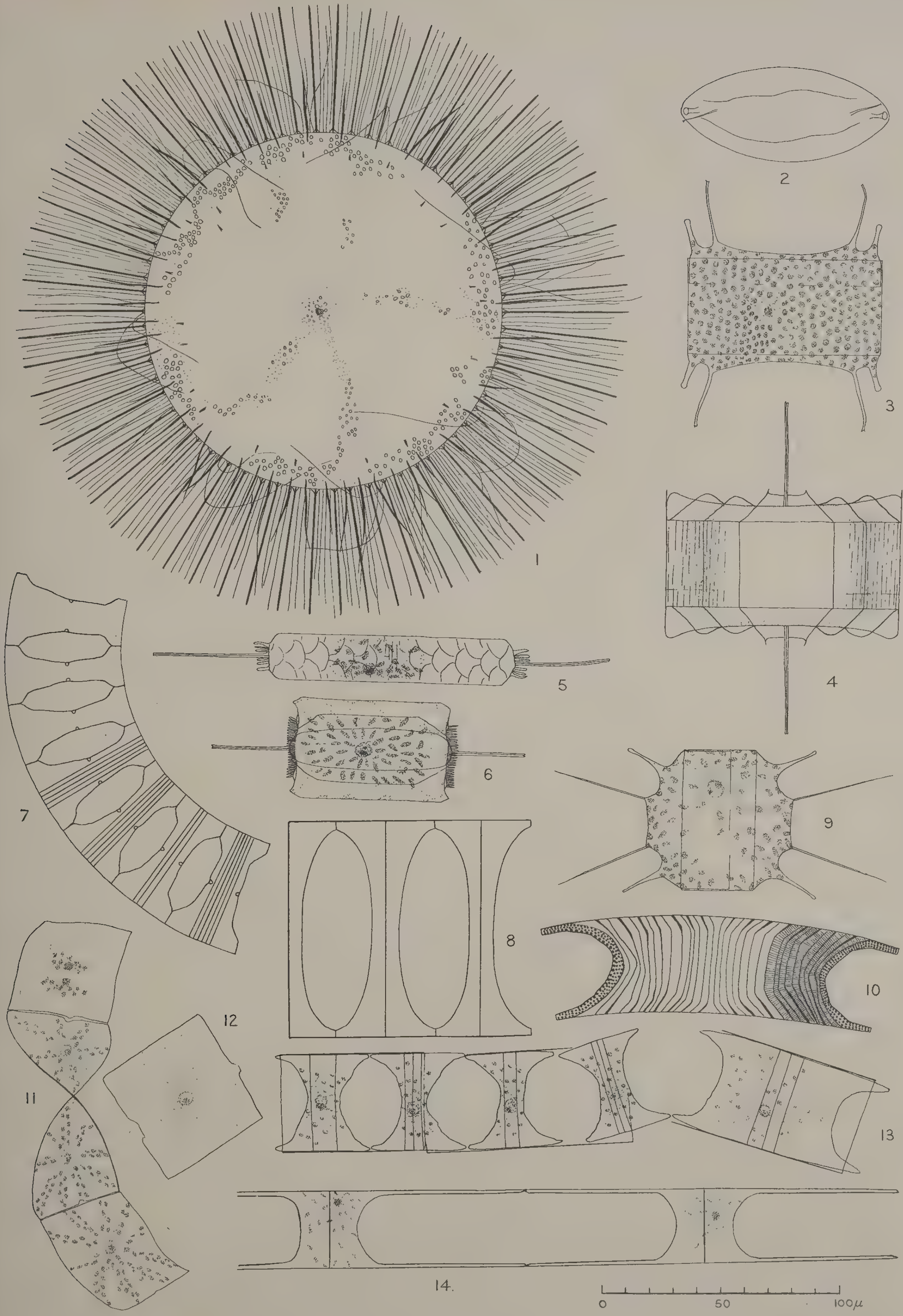
Fig. 10. *Eucampia cornuta* Cleve; cell in girdle view showing the striate bands of the connective zone.

Fig. 11. *Streptotheca thamesis* Shrubsole; cells in spiral ribbon formation, showing chromatophores arranged upon protoplasmic threads which radiate from the nucleus.

Fig. 12. Ditto. A single cell in girdle view.

Fig. 13. *Climacodium biconcavum* Cleve; cells in chain formation, girdle view, showing protoplasmic contents.

Fig. 14. *Hemiaulus Hauckii* Grunow; cells in ribbon formation, showing protoplasmic contents.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# PLATE XIII

Fig. 1. *Planktoniella sol* (Wallich) Schütt; oblique view of cell.

Fig. 2. *Coscinodiscus Grani* Gough; cell in girdle view showing eccentricity of the convexity of the valves (diagrammatic).

Fig. 3. *Coscinodiscus bouvet* Karsten; cell in girdle view (diagrammatic).

Fig. 4. *Coscinodiscus bouvet* Karsten; cell in girdle view, showing one valve more conical than the other (diagrammatic).

Fig. 5. *Biddulphia anthropomorpha* Van Heurck; cells in chain formation, girdle view: hyaline cell at top end of the chain, spinous cell at the lower end.

Fig. 6. *Chaetoceros peruvianum* Brightwell; girdle view showing protoplasmic contents; and striate bristles.

Fig. 7. *Chaetoceros criophilum* Castracane; girdle view showing protoplasmic contents.

Fig. 8. *Eucampia balaustium* Castracane; cell in valve view.

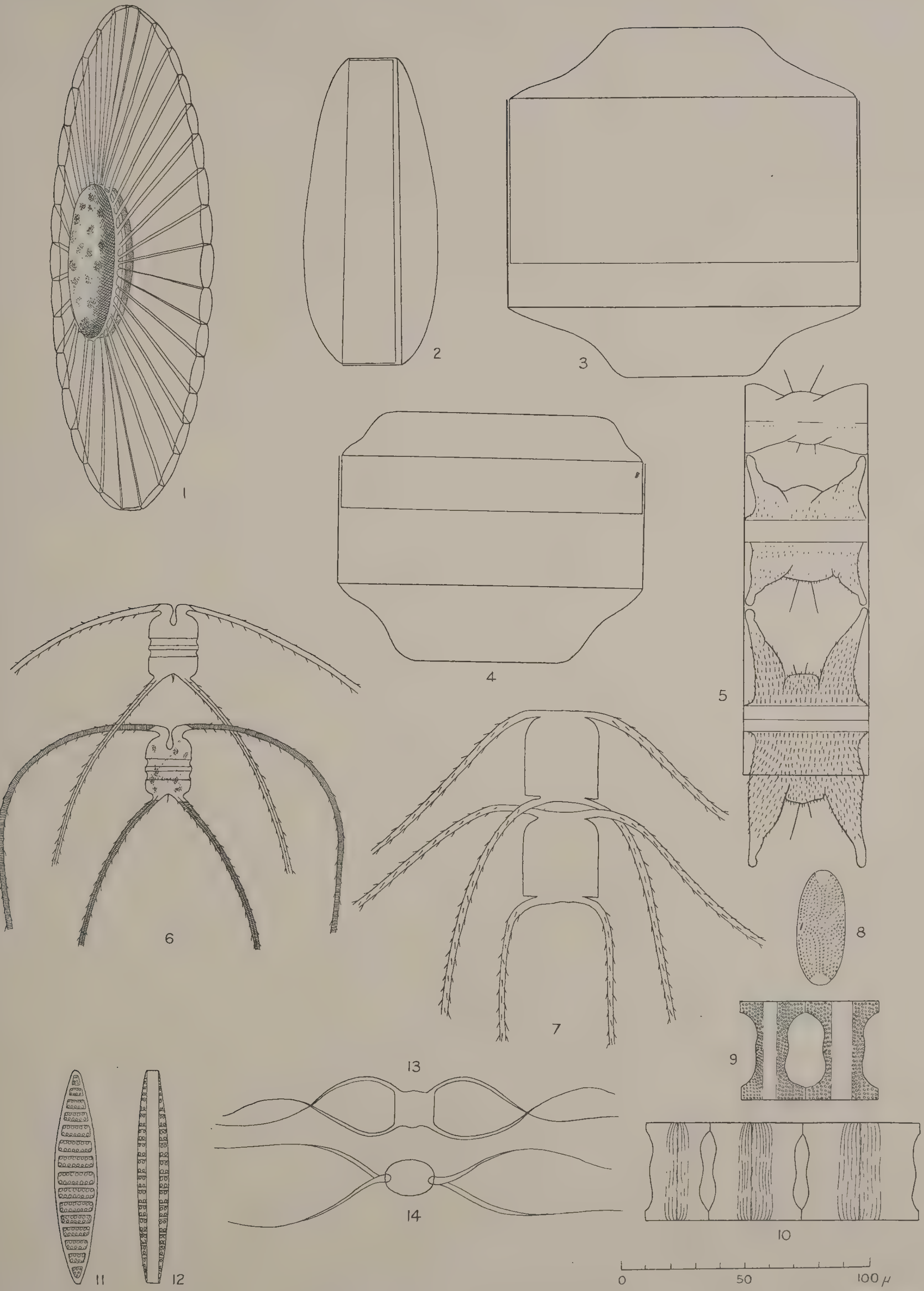
Figs. 9, 10. *Eucampia balaustium* Castracane; cells forming chains, girdle view.

Fig. 11. *Fragilariopsis antarctica* (Castracane) Hustedt; cell in valve view.

Fig. 12. *Fragilariopsis antarctica* (Castracane) Hustedt; cell in girdle view.

Fig. 13. *Chaetoceros Schimperianum* Karsten; cell in girdle view.

Fig. 14. *Chaetoceros Schimperianum* Karsten; cell in valve view.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[*Discovery Reports. Vol. XVI, pp.* 365–412, *April* 1937.]

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# THE SEASONAL CIRCULATION OF THE ANTARCTIC MACROPLANKTON

By

N. A. MACKINTOSH, D.Sc.

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# THE SEASONAL CIRCULATION OF THE ANTARCTIC MACROPLANKTON

By N. A. Mackintosh, D.Sc.

(Text-figs. 1–9)

## INTRODUCTION

The plankton, by its definition, is unable to control its distribution by actively swimming against the currents. Some of the larger organisms might be said to have some power of purposeful locomotion in a horizontal direction, but none can compete with the ocean currents and they must all eventually be carried in the direction of movement of the water mass which surrounds them. In the oceans of the world however we find different species always characterizing different latitudes or regions and inhabiting different depths, and these species keep within the normal limits of their distribution in spite of the fact that the water in which they live is constantly changing—drifting away to warmer or colder regions, sinking from the surface or welling up from the depths. Damas (1905) pointed out that there must be some mechanism which allows the characteristic fauna and flora of oceanic regions to persist. His investigations were concerned with a collection of Copepods from the region between Norway and Iceland, and he suggested that here the organisms were carried away in a circulating current, moving anti-clockwise round the Norwegian Sea, which would bring a certain proportion of the stock back to the environment in which it is able to breed. Helland-Hansen and Nansen (1909) published a detailed account of the hydrology of the Norwegian Sea and refer (on pp. 312–16) to Damas's hypothesis of plankton circulation. They suggest that where certain species are found to be abundant in certain areas they are in a way stationary there, and that the water masses are also more or less stationary, or are renewed comparatively slowly. They found that Damas's areas of abundant Copepods coincided with regions in which a great part of the water probably remains for a long time, exposed only to small circulatory movements in various directions. The problem was again taken up by Sømme (1934) who found that *Calanus finmarchicus* and *C. hyperboreus* migrated into deep water during the winter in the Lofoten area, and rose towards the surface in spring. He suggested that this migration was a means by which the species avoided the scattering effect of the swiftly moving surface currents.

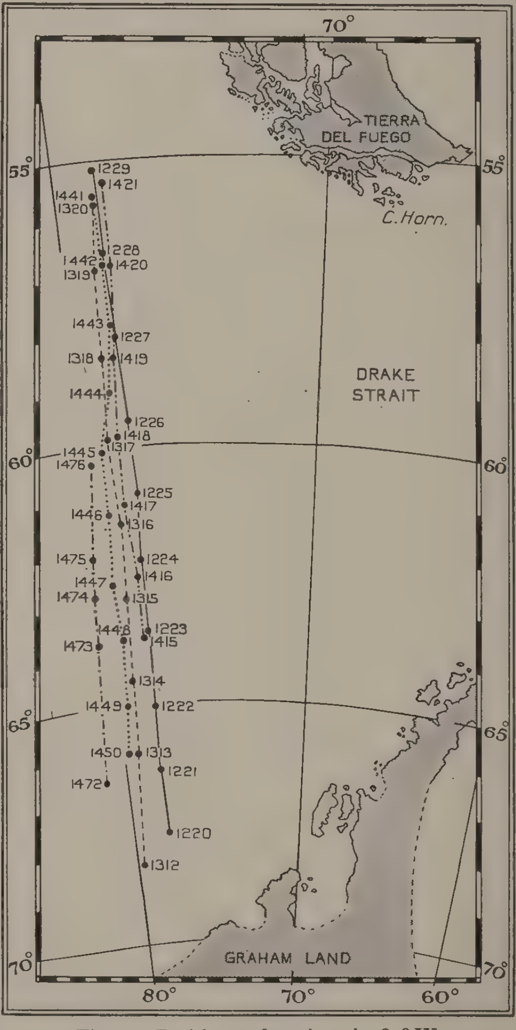
In the present paper it will be shown that certain species of the Antarctic macroplankton, which are usually regarded as inhabitants of the surface layers, make an annual vertical migration into surprisingly deep water in winter, and that this migration, by which they move from one current system to another, is probably the means by which they keep within their normal geographical boundaries. A preliminary account of this migration was published in *Nature*, October 19th, 1935.

# STATIONS OF THE R.R.S. 'DISCOVERY II' IN THE MERIDIAN OF 80° W

Before the 'Discovery II' sailed in 1933 on her third commission it was felt that some more precise information was needed on the seasonal changes which take place in the physical and biological conditions in Antarctic waters. It was therefore decided to make a series of observations on a fixed line, and to repeat them several times during the commission. Such repeated observations are not only required for the examination of seasonal changes. They are of value in the study of the cause and effect of any phenomenon of oceanic distribution.

Since the normal conditions in the Southern Ocean naturally vary much more from north to south than from east to west it was evident that the most comprehensive results would accrue from a line of stations running north and south along a fixed meridian. For several reasons the meridian of 80° W was chosen for this purpose. Here the Antarctic zone is comparatively narrow and can be traversed in a short space of time, and the currents are less affected by disturbing land masses than, say, in the neighbourhood of the Scotia Sea. It was possible also to make repeated visits to this particular region without sacrificing other projected work in the Atlantic and Pacific sectors.

During the whole commission five lines of stations were worked in approximately 80° W. These were in December, 1933, and in March, September, October and November, 1934. Some details of the stations are given in Table I, and their positions are shown in Fig. 1. It was our practice each time to work two stations a day, one at 9 a.m. and one at 8 p.m. At each station temperatures and water samples were taken at the usual depths (see Station Lists in the *Discovery Reports*), though at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1313
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1472
1220
1312
GRAHAM LAND
70°
70°
80°
70°
60°

Fig. 1. Positions of stations in 80° W.

Table I. *Stations near the meridian of* 80° *W*

| Station No. | Date | Hour | Position | | Hydrological observations | N 70 V net series |
|---|---|---|---|---|---|---|
| | | | South latitude | West longitude | | |
| 1220 | 13. xii. 33 | 2100 | 67° 45′ | 77° 51′ | To bottom | 0–1000 m. |
| 1221 | 14. xii. 33 | 0900 | 66° 26′ | 78° 02′ | ,, 2000 m. | ,, |
| 1222 | 14. xii. 33 | 2000 | 65° 03′ | 78° 02′ | ,, bottom | ,, |
| 1223 | 15. xii. 33 | 0900 | 63° 32′ | 78° 02′ | ,, 2000 m. | ,, |
| 1224 | 15. xii. 33 | 2000 | 62° 11′ | 78° 01′ | ,, bottom | ,, |
| 1225 | 16. xii. 33 | 0900 | 60° 54′ | 77° 58′ | ,, 2000 m. | ,, |
| 1226 | 16. xii. 33 | 2000 | 59° 32′ | 78° 04′ | ,, bottom | ,, |
| 1227 | 17. xii. 33 | 0900 | 58° 05′ | 78° 17′ | ,, 2000 m. | ,, |
| 1228 | 17. xii. 33 | 2000 | 56° 39′ | 78° 32′ | ,, bottom | ,, |
| 1229 | 18. xii. 33 | 0900 | 55° 11′ | 78° 30′ | ,, bottom | ,, |
| 1312 | 10. iii. 34 | 1530 | 68° 18′ | 79° 34′ | To bottom | 0–1000 m. |
| 1313 | 11. iii. 34 | 0900 | 66° 02′ | 79° 22′ | ,, 2000 m. | ,, |
| 1314 | 11. iii. 34 | 2000 | 64° 31′ | 79° 14′ | ,, bottom | ,, |
| 1315 | 12. iii. 34 | 0900 | 62° 55′ | 79° 06′ | ,, 2000 m. | ,, |
| 1316 | 12. iii. 34 | 2000 | 61° 27′ | 78° 59′ | ,, bottom | ,, |
| 1317 | 13. iii. 34 | 0900 | 59° 55′ | 79° 00′ | ,, 2000 m. | ,, |
| 1318 | 13. iii. 34 | 2000 | 58° 26′ | 78° 54′ | ,, bottom | ,, |
| 1319 | 14. iii. 34 | 0900 | 56° 56′ | 78° 46′ | ,, 2000 m. | ,, |
| 1320 | 14. iii. 34 | 2000 | 55° 45′ | 78° 29′ | ,, bottom | ,, |
| 1415 | 12. ix. 34 | 2000 | 63° 41′ | 78° 03′ | To bottom | 0–1500 m. |
| 1416 | 13. ix. 34 | 0900 | 62° 31′ | 78° 18′ | ,, 2000 m. | 0–1000 m. |
| 1417 | 13. ix. 34 | 2000 | 61° 05′ | 78° 34′ | ,, bottom | ,, |
| 1418 | 14. ix. 34 | 0900 | 59° 50′ | 78° 34′ | ,, 2000 m. | ,, |
| 1419 | 14. ix. 34 | 2000 | 58° 24′ | 78° 25′ | ,, bottom | 0–1500 m. |
| 1420 | 15. ix. 34 | 0900 | 56° 53′ | 78° 14′ | ,, 2000 m. | 0–1000 m. |
| 1421 | 15. ix. 34 | 2000 | 55° 22′ | 78° 11′ | ,, bottom | 0–1500 m. |
| 1441 | 26. x. 34 | 0900 | 55° 39′ | 78° 38′ | To 1000 m. | 0–1000 m. |
| 1442 | 26. x. 34 | 2000 | 56° 49′ | 78° 26′ | ,, 400 m. | ,, |
| 1443 | 27. x. 34 | 0900 | 57° 49′ | 78° 24′ | ,, bottom | ,, |
| 1444 | 27. x. 34 | 2000 | 59° 03′ | 78° 45′ | ,, 2000 m. | ,, |
| 1445 | 28. x. 34 | 0900 | 60° 07′ | 79° 18′ | ,, bottom | 0–750 m. |
| 1446 | 28. x. 34 | 2000 | 61° 15′ | 79° 26′ | ,, 2000 m. | 0–1000 m. |
| 1447 | 29. x. 34 | 0900 | 62° 38′ | 79° 29′ | ,, bottom | ,, |
| 1448 | 29. x. 34 | 2000 | 63° 44′ | 79° 22′ | ,, 2000 m. | ,, |
| 1449 | 30. x. 34 | 0900 | 65° 03′ | 79° 24′ | ,, bottom | ,, |
| 1450 | 30 x. 34 | 2000 | 66° 03′ | 79° 42′ | ,, bottom | ,, |
| 1472 | 14. xi. 34 | 2000 | 66° 32′ | 81° 18′ | To bottom | 0–1000 m. |
| 1473 | 15. xi. 34 | 2000 | 63° 47′ | 80° 40′ | ,, bottom | ,, |
| 1474 | 16. xi. 34 | 0900 | 62° 50′ | 80° 28′ | ,, 2000 m. | ,, |
| 1475 | 16. xi. 34 | 2000 | 62° 05′ | 80° 19′ | ,, bottom | ,, |
| 1476 | 17. xi. 34 | 1600 | 60° 21′ | 79° 54′ | ,, bottom | ,, |

alternate stations (usually in the morning) the series was taken only to 2000 m. instead of to the bottom. At each station also the 70 cm. closing plankton nets were hauled vertically at six different depths between the surface and 1000 m., with an additional haul from 1500 m. at some stations in September, and various hauls were made with other nets, both vertical and oblique. It is with the samples from the vertical closing nets that this paper is principally concerned.

Except in October the 'Discovery II' began each line in the south and worked northwards, and in all five of the lines the most southerly station was at the edge of the pack-ice. It is desirable to extend such lines as far south as possible, but no useful purpose would have been served in any attempt to penetrate farther south, for the gear cannot be used in the pack. The most northerly station lay between 55° and 56° S in each line except the last which was cut short owing to the necessity for refuelling the ship. However it came only a fortnight later than the preceding line and it was not considered necessary to carry it so far north. It will be seen that the lines varied in longitude from about 78 to 81° W. This slight deviation from a fixed longitude is probably of no importance, and it would in any case have been extremely difficult to bring the lines closer together without loss of time and working stations at irregular hours.

The distances between the stations can be read without difficulty from Table I. Since the lines run almost due north and south the difference in minutes of latitude between successive stations is equivalent to the number of miles which separates them. Thus St. 1220 is 1° 19′ south of St. 1221, i.e. 79 miles. The total length of each line and the average distance between the stations are as follows:

| | | Length miles | Av. intervals miles |
|---|---|---|---|
| December | Sts. 1220–29 | 754 | 84 |
| March | „ 1312–20 | 753 | 94 |
| September | „ 1415–21 | 499 | 83 |
| October | „ 1441–50 | 624 | 69 |
| November | „ 1472–76 | 371 | 93 |

The construction and method of handling the 70 cm. closing plankton net, which is hauled vertically for quantitative investigations, has been described in detail by Kemp and Hardy (1929, pp. 183 and 199). The effective straining part of the net is made of silk with 74 meshes to the linear inch; the opening is 70 cm. in diameter and the speed of hauling is 1 m. per second. The net is closed on the Nansen principle by messenger, release gear and throttling rope. At all the stations in 80° W this net, which is usually referred to as the N 70 V, was hauled through the usual series of six depths. These are from 50 m. to the surface, 100 to 50 m., 250 to 100 m., 500 to 250 m., 750 to 500 m. and 1000 to 750 m. At three of the winter stations (1415, 1419 and 1421) an extra deep haul was made from 1500 to 1000 m.

In working the lines of stations in 80° W we were extremely fortunate in meeting with no gales or strong head winds which might have resulted in an incomplete series of samples and irregularity in the spacing of the stations. Actually out of 250 samples required, 248 were successfully collected and analysed, one was spilt in the laboratory before analysis (St. 1445, 1000–750 m.) and one attempted haul at St. 1417, 1500–1000 m. failed through premature closing of the net.

The N 70 V is designed to catch the medium and smaller sized constituents of the animal plankton, and although the average volume of the samples is small in comparison with that of a sample from, say the oblique 1-m. net, the number and diversity of the organisms may be very large. A complete analysis of these catches is a very laborious process, and a single sample requires rather more than a full day's work. It occurred to me however that some useful information on the vertical distribution of the macroplankton might be obtained from an abbreviated or preliminary form of analysis, and I found that it was possible, by picking out and counting only the larger organisms, to work through six or seven samples quite easily in one day. A disadvantage of this method of course is that it may be difficult to define the difference between those organisms which should be picked out, and those which should be disregarded. In the samples at least from this particular region the difficulty was not so great as might be thought. It was found that if those species were picked out which we are normally accustomed to find in the 1-m. nets the residue generally consisted of smaller species and larval forms which could be confidently disregarded. The result is very much the same, with the exception perhaps of one or two species, if one picks out only those organisms which can be identified with the naked eye or a low-powered lens. Acting on these criteria I have had no difficulty in estimating the numbers of the more important species of the macroplankton. One or two genera such as *Metridia* and *Limacina* were represented in some samples by large numbers of immature specimens which were difficult to identify with certainty and would probably not have been retained in the 1-m. net, and these species I have disregarded in the subsequent treatment of the analyses. Of such species as *Rhincalanus gigas* however, which are easily identifiable, I have counted every specimen recognizable by the naked eye, and a small proportion of these would probably have been too small to be retained in the 1-m. nets.

It has frequently been pointed out that in plankton work of this kind which involves the examination of large quantities of material it is impossible to attain complete accuracy in the analysis of the samples. Mistakes in identification may occur now and then and small inaccuracies in counting the individuals are liable to occur, especially if subsamples are taken. The figures quoted in Table II for instance might require some corrections if the samples were subjected to a more careful and prolonged analysis, but there could be no very important change in the order of abundance of the species. Samples from these vertical closing nets however give a much more reliable indication of quantitative distribution than the samples from the towed nets such as the 1-m. and 70-cm. oblique nets (N 100 B and N 70 B). Differing weather conditions cause much variation in the depth to which the towed nets sink and to the speed at which they move through the water, but the vertical nets can always be hauled at the correct speed through the required depths and closed at the right moment.

## PLANKTON SPECIES EXAMINED IN 80° W

In a previous paper on the Antarctic macroplankton (1934, p. 97) I gave a list of species arranged in order of the abundance in which they occurred in the 1-m. oblique nets. Table II here shows the relative abundance of macroplankton species taken in the N 70 V in 80° W. Those species which could be identified with some confidence are separated from the more doubtful species. This list differs from the previous one in several details, principally because the plankton population in 80° W differs in some important respects from that of the south west Atlantic from which the material in my previous paper was mostly drawn. Some differences are also due to the smaller capacity of the N 70 V to catch the larger organisms. In Table II also the different species of Chaetognatha are distinguished, while in the old list they were not. It must further be remembered that we are dealing here with the plankton from all depths between the surface and 1000 m.; but although in the deeper hauls we find a higher proportion of species which do not occur in the Antarctic surface water, the bulk of the macroplankton is still made up of species which are commonly taken in the 1 m. nets hauled in the upper layers.

Table II. *Relative abundance of species in 80° W.*
*Showing total numbers taken in all N 70 V samples.*

| | | | |
|---|---|---|---|
| *Rhincalanus gigas* | 17784 | *Parathemisto gaudichaudi*, adult | 43 |
| *Eukrohnia hamata* | 12414 | *Calanus propinquus*, adult | 42 |
| *Calanus acutus* | 9091 | *Primno macropa*, adult | 38 |
| *Pleuromamma robusta* | 1566 | *Euphausia triacantha* | 28 |
| *Sagitta maxima* | 963 | *Euphausia vallentini* | 28 |
| *Sagitta gazellae* | 560 | *Euphausia frigida* | 20 |
| *Sagitta planctonis* | 370 | *Clione antarctica*, large | 7 |
| *Dimophyes arctica* | 268 | *Haloptilus ocellatus* | 5 |
| *Parathemisto gaudichaudi*, juv. | 258 | *Auricularia antarctica* | 2 |
| *Conchoecia hettacra* | 234 | *Diphyes antarctica* | 2 |
| *Primno macropa*, juv. | 221 | *Sibogita borchgrevinki* | 1 |
| *Eukrohnia hamata* f. *antarctica* | 196 | *Vanadis antarctica* | 1 |
| *Haloptilus oxycephalus* | 57 | | |

Identification doubtful

| | | | |
|---|---|---|---|
| Small Calanoids | 14992 | *Spongiobranchaea australis* | 41 |
| *Clione antarctica*, small | 227 | *Solmundella mediterranea* | 16 |
| *Conchoecia symmetrica* | 133 | *Cleodora sulcata* | 6 |
| *Conchoecia antipoda* | 127 | | |

Only genus identified

| | | | |
|---|---|---|---|
| *Eucalanus* | 4249 | *Tomopteris*, small | 135 |
| *Pareuchaeta* | 903 | *Euchirella*, adult | 99 |
| *Thysanoessa* | 310 | *Candacia* | 32 |
| *Heterorhabdus* | 292 | *Beroë* | 4 |
| *Pleurobrachia* | 251 | *Tomopteris*, large | 3 |
| *Euchirella*, juv. | 215 | | |

Observed but not counted

Radiolaria
*Pyrostephos vanhöffeni*
*Metridia gerlachei*
Euphausiidae, juv.
*Limacina helicina*
*Limacina balea*

Table II shows that in 80° W, as in other parts of the Antarctic, a large part of the plankton is made up of the Copepods *Rhincalanus gigas* and *Calanus acutus*, and the Chaetognath *Eukrohnia hamata*; but the adult *Calanus propinquus* which is very abundant in some parts of the Atlantic sector was here comparatively scarce. Certain small Calanoids were sometimes taken in large numbers. *C. simillimus* made up a certain proportion of these but the majority were difficult to identify, and there was usually some doubt as to whether they should be picked out or disregarded as being too small. Some species such as *Parathemisto gaudichaudi* and *Primno macropa* were usually clearly adult or definitely smaller and clearly immature. In such cases the large and small examples have been listed separately. The sizes of others, such as *Rhincalanus* and *Eukrohnia* were too evenly graded for such a distinction to be made.

## THE DRIFT OF THE PLANKTON

The distribution and movements of the various water masses of the Southern Ocean have been described in a number of recent publications. The movements of certain of these layers however are intimately concerned with the subject of this paper, and a brief account of them must therefore be repeated here. For fuller information reference should be made to Wüst (1928 and 1933), Clowes (1933), Deacon (1933 and 1937) and Sverdrup (1933).

"In the Antarctic Zone the surface layer is composed of cold poorly saline water, which lies in a shallow well-defined layer above warmer deep water. It has a depth of 100–250 m., and is separated from the warm water below it by a discontinuity layer, within which the temperature and salinity increase rapidly with depth." (Deacon, 1933, p. 173). This layer of Antarctic surface water is bounded in the south by the Antarctic continent and in the north by the Antarctic convergence where it meets the warmer sub-Antarctic water. Below it is the much thicker layer of the warm deep water, and below that again is the Antarctic bottom water. Except in the highest latitudes the movement of all these layers in the Southern Ocean is in general from west to east, but there is a northerly component in the movement of the surface and bottom layers and a compensating southerly component in the movement of the warm deep water. In the Antarctic surface layer there is thus a continuous transport of water to the north, and when this water reaches the Antarctic convergence it sinks abruptly below the sub-Antarctic water, and there is a sharp rise of temperature at the surface.

Fig. 2 is a vertical section of the first 1000 m. of water in the meridian of 80° W and shows diagrammatically the disposition of the surface and warm deep waters and the north and south components in the movement of the water. The principal flow of the water may be imagined as taking place at right angles to the plane of the page and towards the observer, and the arrows represent the tendency for the water to work gradually northwards at the surface and southwards deeper down. It will be noticed that the warm deep water tends to rise towards the surface as it moves south, but it must be remembered that the vertical scale of the section is greatly exaggerated. The relative strength of the easterly and northerly components of the drift of the Antarctic surface water varies considerably in different parts of the Antarctic. In some places the resultant direction of the transport of water is north-east, in others east, and sometimes it may for a time be even a little south of east. In general it may be said that the easterly component is considerably stronger than the northerly.

If an organism were floating quite passively in the Antarctic surface water it would eventually be transported northwards to the Antarctic convergence. Here it would be carried down below the sub-Antarctic surface water and, unless it was caught up in a returning current, would continue to move northwards in the increasingly warm Antarctic intermediate layer, finally reaching a foreign environment in which it could not possibly survive. Thus if the whole plankton population floated passively in the Antarctic surface layer it would soon disappear. There must therefore be some form of circulation by which the organisms or their offspring are able to find their way back to the southern limits of the zone they inhabit. The means by which this circulation is effected is a problem of fundamental importance, for it is probably the principal factor in the distribution of species and quantities of plankton.

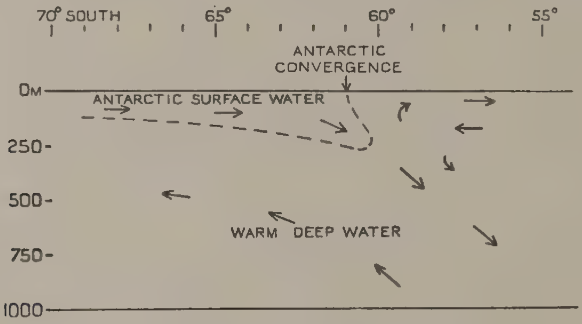


Fig. 2. Water movements in 80° W.

Although they must drift with the horizontal currents the plankton organisms are able to transfer themselves from one layer of water to another, either by swimming actively in a vertical direction or perhaps by altering their specific gravity. Hardy and Gunther (1935, pp. 311 *et seq.*) discuss at considerable length the possibility that these organisms can 'navigate' themselves by making use of superimposed currents travelling in different directions and at different speeds. Most organisms for instance undergo daily vertical migrations, rising towards the surface at night and sinking into deeper water during the day, and in some cases at least these migrations are sufficiently extensive to bring the organism from the Antarctic surface layer, which is moving in one direction, into the warm deep water which is moving in another. It is suggested that by varying the range of vertical movement, or the length of time spent in one layer or the other, the organism can in some degree control the ultimate direction in which it drifts. There can be no doubt that the horizontal movements of such migrating organisms are the resultant effects of the two currents, but diurnal migrations will not be a sufficient means of keeping the bulk of the plankton permanently within its normal boundaries.

During the summer season, when the vast majority of observations on the Antarctic plankton have in the past been made, the organisms are mostly concentrated in the surface layer day and night. Some of the more abundant species have no very marked diurnal migrations, and many others do not make sufficiently extensive journeys into the warm deep water to counterbalance their northward transport in the surface layer. Observations on the Antarctic plankton in winter have been comparatively few, but it will be shown in the following pages that in the meridian of 80° W, and in other places where samples have been collected in winter, a large part at least of the plankton at that time of year has descended bodily into the warm deep water.

## HYDROLOGICAL SECTIONS

Mr A. J. Clowes of the Discovery staff has kindly assisted me in plotting the temperature sections shown in Fig. 3 and has drawn my attention to the more important features in each.

Fig. 3*a* shows the vertical distribution of temperature in 80° W in December 1933. Half of this line of stations was in Antarctic water and half in sub-Antarctic water, the Antarctic convergence being crossed between stations 1224 and 1225. This convergence may be defined as the point at which the Antarctic surface layer sinks below 250 m. The Antarctic surface layer is seen here as a tongue of cold water in the upper left-hand part of the section. The water in it varies in temperature from $-1{\cdot}5°$ C. to nearly $+2{\cdot}0°$ C. It is also seen that the convergence is marked by a sharp rise of temperature at the surface. The upper right-hand part of the section is occupied by sub-Antarctic water and some intermediate isotherms are inserted as pecked lines below it to show how the cold Antarctic water pushes on northwards to become eventually the 'Antarctic intermediate layer'. This is a layer which is not always very clearly defined immediately to the north of the convergence, for here considerable mixing takes place with other layers. The 'warm deep' water occupies the lower left-hand part of the section. Below the Antarctic surface water it varies in temperature from $+1{\cdot}5°$ C. to $2{\cdot}5°$ C. The shape of the $2{\cdot}0°$ isotherm gives a good idea of the southward, and slightly upward, thrust of this body of water.

The same layers of water appear in much the same positions in March, but temperatures in the surface layers are higher all round, especially on the surface itself where the temperature at any given point is about 2° C. higher that at the corresponding point in December. (Temperatures in the Antarctic are usually expected to reach the maximum late in February.) A peculiarity of this section is that although the true Antarctic convergence lies between Sts. 1316 and 1317 a shallow layer of sub-Antarctic water has been pushed southwards over the Antarctic surface water a little past St. 1315. Here we have five stations in Antarctic, and four in sub-Antarctic water.

In September the pack-ice lay far to the north and only two stations could be worked between it and the convergence. The latter is very poorly defined but it must be between Sts. 1416 and 1417. The sections for March and September show the principal contrast between summer and winter. In March not only are the surface temperatures relatively

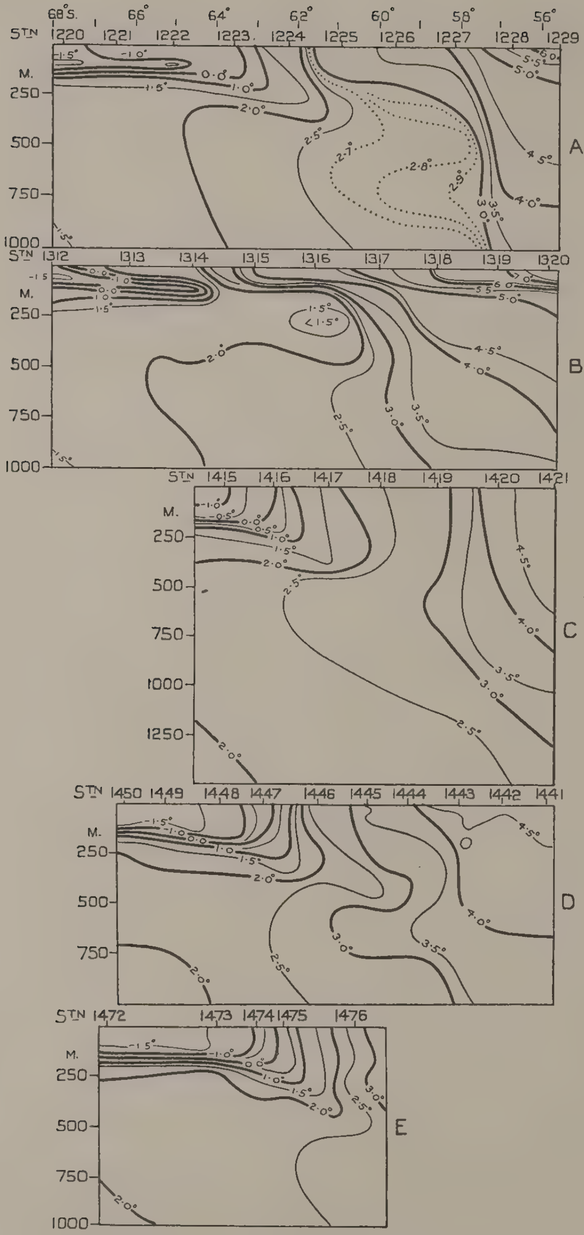


Fig. 3. Vertical distribution of temperature in 80° W. *A*, December; *B*, March; *C*, September; *D*, October; *E*, November.

high but in the surface waters of both the Antarctic and sub-Antarctic regions the isotherms are nearly all horizontal. This indicates a stable condition of the upper layers. In September on the other hand the isotherms are nearly all vertical. This indicates considerable mixing in the surface layers of both Antarctic and sub-Antarctic water. The conditions in December are intermediate.

In October the convergence is quite clearly defined at the surface, and the section shows the beginning of a transition from winter to spring conditions. The sinking Antarctic water shows a thrust to the north which is hardly discernible in September.

Continuous bad weather prevailed in the short interval between the October and November lines, and this is reflected throughout the section in the steepness of the isotherms which cut the surface in November. Intense vertical mixing has again taken place with a consequent reversion towards winter conditions. The Antarctic convergence was obliterated but it must be considered to lie between Sts. 1475 and 1476.

## VERTICAL DISTRIBUTION OF THE PLANKTON IN 80° W

The sections described above, which show the vertical distribution of temperature, are much more accurate and reliable than any sections we can construct to show the vertical distribution of the plankton. The former are based on a large number of temperature readings at accurately located points. Of these there are sixteen in the first 1000 m. at each station. For the plankton sections we cannot determine the concentration of a species at any particular point; we only know its total relative concentration in the six or so columns of water through which the N 70 V is fished. However, the data are sufficient to justify the drawing of a vertical section so long as its limitations are borne in mind.

The normal series of hauls with these nets is quite appropriate to the positions of the water layers. Thus at any station south of the Antarctic convergence there is no doubt that everything in the samples from 50–0 and 100–50 m. can only have come from the Antarctic surface layer. Hauls from 250–100 m. will usually cover part of the surface layer and part of the warm deep layer, and hauls below this will be exclusively from the warm deep water. The normal series of hauls does not of course reach the Antarctic bottom water.

The best method perhaps of illustrating the vertical distribution of the plankton is to plot the number counted in each sample in the mean position of the haul. Table III shows the figures for all species of the macroplankton picked out and counted, and there are separate sections for each month in which the line of stations in 80° W was repeated. The larger hauls are emphasized by heavy type. Allowance has been made for the length of hauls at different depths. Thus a haul from 1000 to 750 m. filters a column of water five times as long as a haul from 100 to 50 m. The numbers of each species have therefore been multiplied by 5 in hauls of 50 m., by $\frac{5}{3}$ in hauls of 150 m., by 1 in hauls of 250 m., and by $\frac{1}{2}$ in hauls of 500 m. Each station is plotted in its proper position according to the scale of latitude at the top, but in order to show all the figures clearly it has been necessary to distort the vertical scale slightly in this and the following tables.

## Table III. *Total macroplankton*

Degrees South: 69 68 67 66 65 64 63 62 61 60 59 58 57 56 55 54

DECEMBER

| | St. 1220 | 1221 | 1222 | 1223 | 1224 | A C ↓ | 1225 | 1226 | 1227 | 1228 | 1229 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 m.–50 | 45 | 105 | 0 | 270 | 360 | | 255 | **1340** | 425 | **835** | **1805** |
| 50–100 | 105 | 275 | 120 | **2250** | **2600** | | **2765** | **3125** | **2340** | **1255** | **2165** |
| 100–250 | 247 | **598** | 222 | 308 | **1022** | | **1402** | **1633** | 498 | **608** | 232 |
| 250–500 | 328 | 209 | 307 | 121 | 134 | | 101 | 159 | 140 | 157 | 96 |
| 500–750 | 240 | 72 | 87 | 100 | 85 | | 113 | 80 | 117 | 93 | 131 |
| 750–1000 | 24 | 9 | 70 | 23 | 48 | | 17 | 25 | 31 | 67 | 62 |

MARCH

| | St. 1312 | 1313 | 1314 | 1315 | 1316 | A C ↓ | 1317 | 1318 | 1319 | 1320 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 m.–50 | 100 | 90 | **635** | **8140** | **14950** | | **3835** | **4755** | **4815** | **1135** |
| 50–100 | **900** | **800** | **1025** | **4240** | **2520** | | **5700** | **4355** | **3700** | **1800** |
| 100–250 | 122 | 167 | **568** | 455 | **680** | | 428 | 497 | ? | 173 |
| 250–500 | 135 | 179 | 265 | 447 | 423 | | 213 | 310 | 417 | 108 |
| 500–750 | 128 | 41 | 87 | 269 | 180 | | 280 | **1229** | **547** | 272 |
| 750–1000 | 145 | 44 | 69 | 80 | 84 | | 53 | **513** | 479 | 73 |

SEPTEMBER

| | St. 1415 | 1416 | A C ↓ | 1417 | 1418 | 1419 | 1420 | 1421 |
|---|---|---|---|---|---|---|---|---|
| 0 m.–50 | 80 | 30 | | 330 | 85 | 115 | 40 | 305 |
| 50–100 | 140 | 110 | | 250 | 90 | 145 | 55 | 450 |
| 100–250 | 107 | 65 | | 183 | 302 | 87 | 38 | 337 |
| 250–500 | 460 | **559** | | 410 | 324 | 382 | 115 | 170 |
| 500–750 | 412 | 301 | | **622** | **585** | **898** | **558** | 378 |
| 750–1000 | 258 | 316 | | 294 | 459 | 315 | 300 | 340 |
| 1000–1500 | 194 | ? | | ? | ? | 208 | ? | 207 |

OCTOBER

| | St. 1450 | 1449 | 1448 | 1447 | A C ↓ | 1446 | 1445 | 1444 | 1443 | 1442 | 1441 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 m.–50 | 45 | 30 | 120 | 220 | | **1555** | 230 | **1170** | 80 | 295 | 150 |
| 50–100 | 240 | 70 | 185 | **2570** | | **1210** | 340 | **1050** | 360 | **500** | 275 |
| 100–250 | 253 | **565** | **1210** | **2327** | | **1573** | **760** | **1505** | **1458** | **1268** | 575 |
| 250–500 | **1018** | **948** | 939 | 218 | | 262 | **505** | **516** | 243 | 273 | 214 |
| 500–750 | **572** | **597** | 147 | 251 | | 235 | 279 | 294 | 207 | 163 | 253 |
| 750–1000 | 74 | 137 | 50 | 48 | | ? | ? | 69 | 68 | 32 | 51 |

NOVEMBER

| | St. 1472 | 1473 | 1474 | 1475 | A C ↓ | 1476 |
|---|---|---|---|---|---|---|
| 0 m.–50 | 165 | 75 | 395 | **1100** | | 350 |
| 50–100 | **1525** | **1105** | **1658** | 845 | | 395 |
| 100–250 | **672** | **725** | **658** | **1538** | | **1330** |
| 250–500 | 337 | 107 | 74 | 231 | | 175 |
| 500–750 | 114 | 62 | 56 | 63 | | 111 |
| 750–1000 | 70 | 39 | 32 | 62 | | 28 |

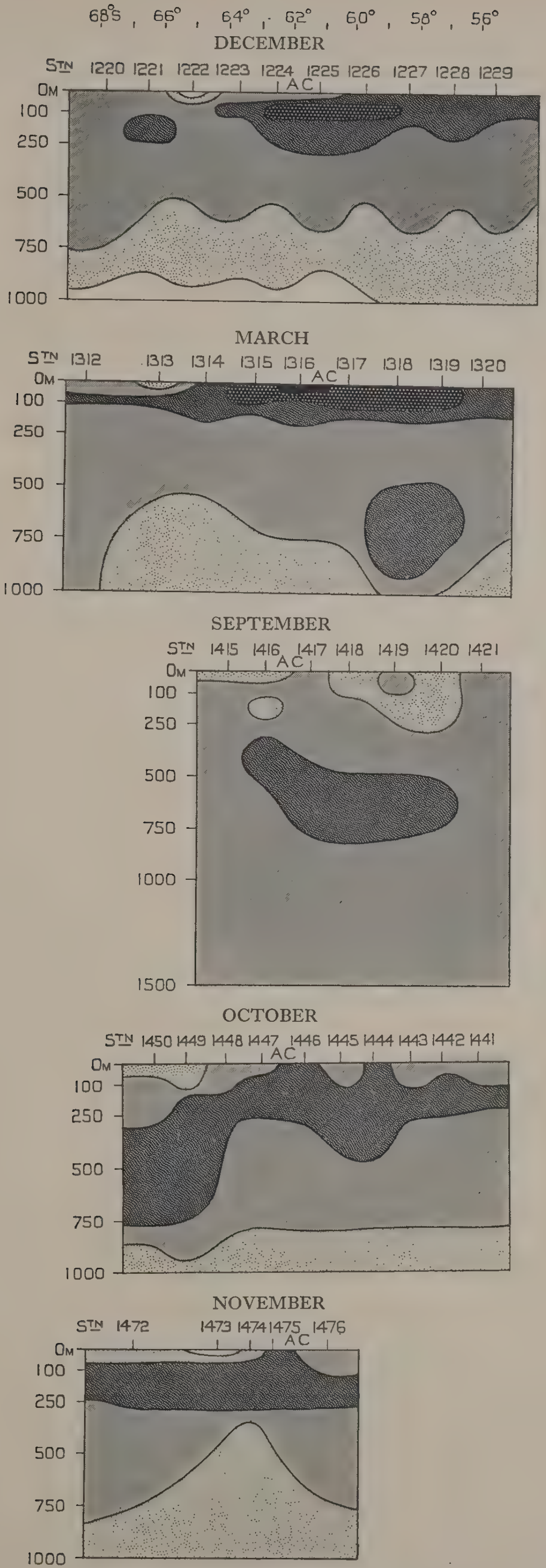


Fig. 4. Vertical distribution of the total macroplankton in 80° W.

It will be remembered that the most southerly station, that is the left-hand end of each section, is at the edge of the pack-ice. The number of organisms counted from each haul is plotted midway between the beginning and end of the haul. For example at St. 1220 in the haul from 500 to 250 m. 328 organisms were counted. The figure 328 is therefore placed at a depth of 375 m. Fig. 4 is drawn in just the same way, but here the vertical scale is undistorted, and the figures are replaced by shaded contouring which shows much more clearly the distribution of the main concentrations of plankton. The contours run through arbitrary numbers, in this case 20, 100, 500, etc. It would probably be safe to say that this macroplankton picked out and counted far exceeds in bulk of organic matter the residue of smaller organisms left in the samples.

The sections show that in December the largest numbers are concentrated near the surface, especially in the neighbourhood of the Antarctic convergence. At this time also there seems to be more plankton in sub-Antarctic than in Antarctic water. The undulations in the contour between 750 and 500 m. are no doubt an effect of the diurnal migrations of certain species.

In March the numbers of organisms have increased. The largest numbers are still near the convergence but there has been a marked development of plankton in the more southerly part of the Antarctic surface layer. The most concentrated regions are now even closer to the surface than in December, but a considerable quantity of plankton appeared, presumably by sinking from above, in deep water on the north side of the convergence.

In September (late winter) the distribution of the plankton is entirely changed. In the first 100 m. of water, which in summer contained the vast majority of organisms, there is now less than at any other depth above 1500 m., and the main concentration lies between 750 and 500 m. The total quantity of plankton at all depths is evidently rather less than in summer, but it is spread over a greater range of depths.

In October we find a reversion towards the summer conditions, but the plankton has not quite risen as high as the December level. The most consistently large catches were those from 250–100 m. and the majority of organisms in them may sometimes have come from the top of the warm deep layer and sometimes from the lower part of the surface layer.

In November (about two weeks later) the plankton seems on the whole to have risen a little higher than in October.

Both the Antarctic surface layer and the upper part of the sub-Antarctic water move gradually towards the north, and it can hardly be doubted that, when the plankton is distributed as it was in 80° W in December and March, the bulk of it must be carried northwards. It seems certain also that the September distribution must involve a southward movement of the plankton. We have evidence then of a general circulation on a very large scale, the majority of organisms drifting northwards in the surface layers in summer, and returning southwards in the warm deep water in winter.

The figures for the total numbers of organisms suffice to show the general effect of this movement, but there are marked differences in the behaviour of separate species. It will be convenient to consider the more important of these species in the order of their relative abundance in 80° W.

The distribution of *Rhincalanus gigas* is shown in Table IV and Fig. 5. Its vertical distribution does not differ very much from that of the total organisms. The largest numbers are usually near the convergence and the maximum concentration in summer is between 100 and 50 m. Some very large catches were taken at this depth in March, but included in these was a considerable proportion of immature specimens. In December the vast majority were found in the surface layers as far south as 64° S. Beyond this latitude the species was scarcer, and living mostly in the warm deep water, as if winter conditions still prevailed in the higher latitudes.

The numbers of this species have everywhere increased in March, especially in the surface layers. Ommanney (1936) finds that it has a spawning period in late November or early December in the Antarctic surface water of the Drake passage and western Scotia Sea. This will account for the large catches in 80° W in March. The proportions of juveniles and adults have not been recorded, but large numbers of young forms were noticed in some of the catches, notably at St. 1317, 100–50 m., and these might well have been hatched about December. Two other points are to be noted in the March distribution. One is the comparatively large number of *R. gigas* now occupying the Antarctic surface water south of 64° S, where the species was extremely scarce in December. The other is the development of a new centre of concentration in deep water to the north of the convergence. The latter phenomenon we have noted in the section for the total number of organisms.

In September the numbers are in general reduced, but the species is almost confined to the warm deep water, the largest quantity being at a depth of round about 500 m. At this depth the deep water is at its warmest (see Fig. 3*c*) and the southward movement no doubt at its strongest. Moderate numbers occur even at depths below 1000 m.

The stations in October were worked about six weeks after those in September. During this period *R. gigas* had risen towards the surface again and we see the greatest concentration as well as the nearest approach to the surface at St. 1447, just to the south of the Antarctic convergence. Farther to the north and to the south the majority are still at a rather lower level, and the numbers are less.

In November also (only two weeks later) the largest numbers were taken on the south side of the convergence. Farther south, and possibly farther north, the species seems a little higher in the water than in October.

This distribution of *R. gigas* in 80° W in spring (October and November) agrees on the whole very well with the results obtained by Ommanney (1936). His analyses of the catches from 1-m. nets, towed obliquely between the surface and about 250 m., showed that in November, 1931, the greatest concentration of this species in 75° W lay immediately to the south of the Antarctic convergence. In October, 1932, in about 80° W, he found the largest numbers at stations a little to the south and a little to the north of the convergence.

The distribution of the Chaetognath, *Eukrohnia hamata* (Table V and Fig. 6) is in

## Table IV. *Rhincalanus gigas*

Degrees South 69 68 67 66 65 64 63 62 61 60 59 58 57 56 55 54

DECEMBER

| m. | St. 1220 | 1221 | 1222 | 1223 | 1224 | A ↓ C | 1225 | 1226 | 1227 | 1228 | 1229 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0–50 | 10 | 5 | 0 | 35 | 230 | | 55 | 175 | 145 | 30 | 120 |
| 50–100 | 15 | 25 | 35 | 1070 | 1620 | | 1065 | 600 | 885 | 255 | 330 |
| 100–250 | 40 | 193 | 67 | 198 | 575 | | 572 | 327 | 113 | 110 | 17 |
| 250–500 | 92 | 44 | 87 | 34 | 13 | | 8 | 8 | 10 | 17 | 3 |
| 500–750 | 109 | 3 | 9 | 33 | 1 | | 0 | 1 | 0 | 6 | 10 |
| 750–1000 | 5 | 0 | 0 | 0 | 0 | | 1 | 0 | 1 | 7 | 4 |

MARCH

| m. | St. 1312 | 1313 | 1314 | 1315 | 1316 | A ↓ C | 1317 | 1318 | 1319 | 1320 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0–50 | 35 | 40 | 220 | 320 | 0 | | 0 | 40 | 0 | 0 |
| 50–100 | 210 | 320 | 615 | 1680 | 970 | | 4400 | 360 | 1080 | 50 |
| 100–250 | 7 | 48 | 132 | 223 | 255 | | 232 | 210 | 78 | 7 |
| 250–500 | 62 | 87 | 102 | 150 | 167 | | 105 | 162 | 301 | 18 |
| 500–750 | 53 | 13 | 33 | 59 | 33 | | 13 | 330 | 232 | 45 |
| 750–1000 | 7 | 3 | 4 | 15 | 11 | | 6 | 44 | 66 | 7 |

SEPTEMBER

| m. | St. 1415 | 1416 | A ↓ C | 1417 | 1418 | 1419 | 1420 | 1421 |
|---|---|---|---|---|---|---|---|---|
| 0–50 | 5 | 0 | | 0 | 0 | 0 | 10 | 10 |
| 50–100 | 20 | 45 | | 0 | 40 | 0 | 0 | 20 |
| 100–250 | 0 | 13 | | 12 | 0 | 2 | 0 | 12 |
| 250–500 | 241 | 324 | | 137 | 72 | 113 | 4 | 3 |
| 500–750 | 83 | 138 | | 308 | 229 | 144 | 38 | 24 |
| 750–1000 | 12 | 52 | | 94 | 165 | 80 | 14 | 26 |
| 1000–1500 | 4 | ? | | ? | ? | 84 | ? | 38 |

OCTOBER

| m. | St. 1450 | 1449 | 1448 | 1447 | A ↓ C | 1446 | 1445 | 1444 | 1443 | 1442 | 1441 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0–50 | 0 | 0 | 45 | 65 | | 90 | 150 | 20 | 15 | 40 | 35 |
| 50–100 | 0 | 20 | 60 | 890 | | 145 | 175 | 35 | 65 | 15 | 25 |
| 100–250 | 95 | 317 | 528 | 1352 | | 773 | 302 | 258 | 307 | 327 | 107 |
| 250–500 | 253 | 235 | 27 | 28 | | 127 | 272 | 193 | 90 | 91 | 94 |
| 500–750 | 8 | 4 | 4 | 11 | | 42 | 72 | 105 | 38 | 56 | 101 |
| 750–1000 | 0 | 1 | 0 | 3 | | ? | ? | 7 | 2 | 2 | 6 |

NOVEMBER

| m. | St. 1472 | 1473 | 1474 | 1475 | A ↓ C | 1476 |
|---|---|---|---|---|---|---|
| 0–50 | 0 | 40 | 25 | 15 | | 180 |
| 50–100 | 140 | 350 | 570 | 95 | | 170 |
| 100–250 | 267 | 283 | 727 | 1107 | | 660 |
| 250–500 | 80 | 10 | 14 | 81 | | 68 |
| 500–750 | 2 | 0 | 1 | 5 | | 9 |
| 750–1000 | 6 | 0 | 0 | 2 | | 0 |

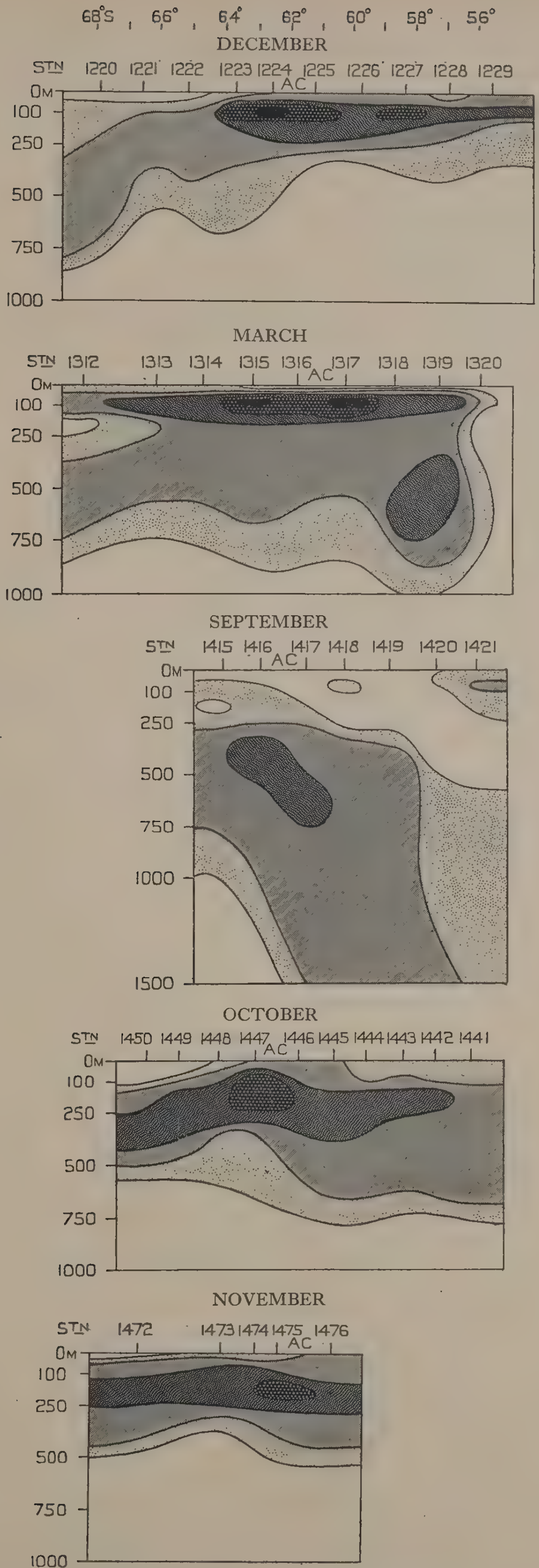


Fig. 5. Vertical distribution of *Rhincalamus gigas* in 80° W.

## Table V. *Eukrohnia hamata*

Degrees South 69 68 67 66 65 64 63 62 61 60 59 58 57 56 55 54

### DECEMBER

| | St. 1220 | 1221 | 1222 | 1223 | 1224 | A ↓ C | 1225 | 1226 | 1227 | 1228 | 1229 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 m.–50 | 10 | 0 | 0 | 25 | 25 | | 25 | 45 | 55 | 15 | **650** |
| 50–100 | 30 | 30 | 15 | **900** | **450** | | **665** | **230** | **1130** | **385** | **1005** |
| 100–250 | 28 | **173** | 33 | 47 | **283** | | **450** | **1140** | **223** | **277** | 63 |
| 250–500 | **120** | 25 | 92 | 25 | 29 | | 38 | 44 | 54 | 72 | 68 |
| 500–750 | 10 | 4 | 18 | 13 | 9 | | 14 | 15 | 15 | 45 | 30 |
| 750–1000 | 9 | 5 | 9 | 4 | 9 | | 4 | 4 | 8 | 26 | 31 |

### MARCH

| | St. 1312 | 1313 | 1314 | 1315 | 1316 | A ↓ C | 1317 | 1318 | 1319 | 1320 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 m.–50 | 5 | 45 | 10 | **355** | **725** | | **305** | **795** | **385** | **280** |
| 50–100 | **350** | **265** | 140 | **420** | **315** | | **1100** | **1275** | **865** | **1125** |
| 100–250 | 67 | 78 | **335** | **133** | **148** | | 57 | 67 | 10 | 43 |
| 250–500 | 32 | 38 | **102** | 81 | 79 | | 47 | 61 | 61 | 43 |
| 500–750 | 18 | 3 | 7 | 14 | 15 | | 48 | **109** | 86 | 14 |
| 750–1000 | 5 | 5 | 12 | 3 | 10 | | 8 | 37 | 39 | 8 |

### SEPTEMBER

| | St. 1415 | 1416 | A ↓ C | 1417 | 1418 | 1419 | 1420 | 1421 |
|---|---|---|---|---|---|---|---|---|
| 0 m.–50 | 0 | 15 | | 0 | 15 | 5 | 0 | 20 |
| 50–100 | 25 | 65 | | 15 | 20 | 40 | 35 | 60 |
| 100–250 | 17 | 45 | | 27 | 38 | 0 | 2 | **165** |
| 250–500 | **166** | **180** | | 99 | **126** | **125** | 65 | 33 |
| 500–750 | 55 | 43 | | 37 | 70 | 62 | 91 | 33 |
| 750–1000 | 16 | 25 | | 40 | 29 | 31 | 26 | 40 |
| 1000–1500 | 10 | ? | | ? | ? | 30 | ? | 9 |

### OCTOBER

| | St. 1450 | 1449 | 1448 | 1447 | A ↓ C | 1446 | 1445 | 1444 | 1443 | 1442 | 1441 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 m.–50 | 5 | 5 | 5 | 40 | | 20 | 40 | 5 | 20 | 15 | 10 |
| 50–100 | 20 | 20 | 20 | **215** | | 30 | 65 | 10 | 15 | 20 | 5 |
| 100–250 | 20 | 92 | **177** | **440** | | **307** | **157** | **165** | **240** | **227** | **160** |
| 250–500 | **138** | **132** | **114** | 53 | | 35 | 51 | 135 | 75 | 61 | 50 |
| 500–750 | 69 | 72 | 34 | 39 | | 36 | 48 | 39 | 49 | 45 | 46 |
| 750–1000 | 23 | 26 | 24 | 12 | | ? | ? | 28 | 27 | 20 | 32 |

### NOVEMBER

| | St. 1472 | 1473 | 1474 | 1475 | A ↓ C | 1476 |
|---|---|---|---|---|---|---|
| 0 m.–50 | 0 | 5 | 55 | 20 | | 20 |
| 50–100 | 25 | 90 | **135** | 85 | | 15 |
| 100–250 | **148** | **148** | 98 | **225** | | **183** |
| 250–500 | 94 | 33 | 20 | 40 | | 55 |
| 500–750 | 21 | 20 | 10 | 17 | | 11 |
| 750–1000 | 21 | 8 | 16 | 12 | | 10 |

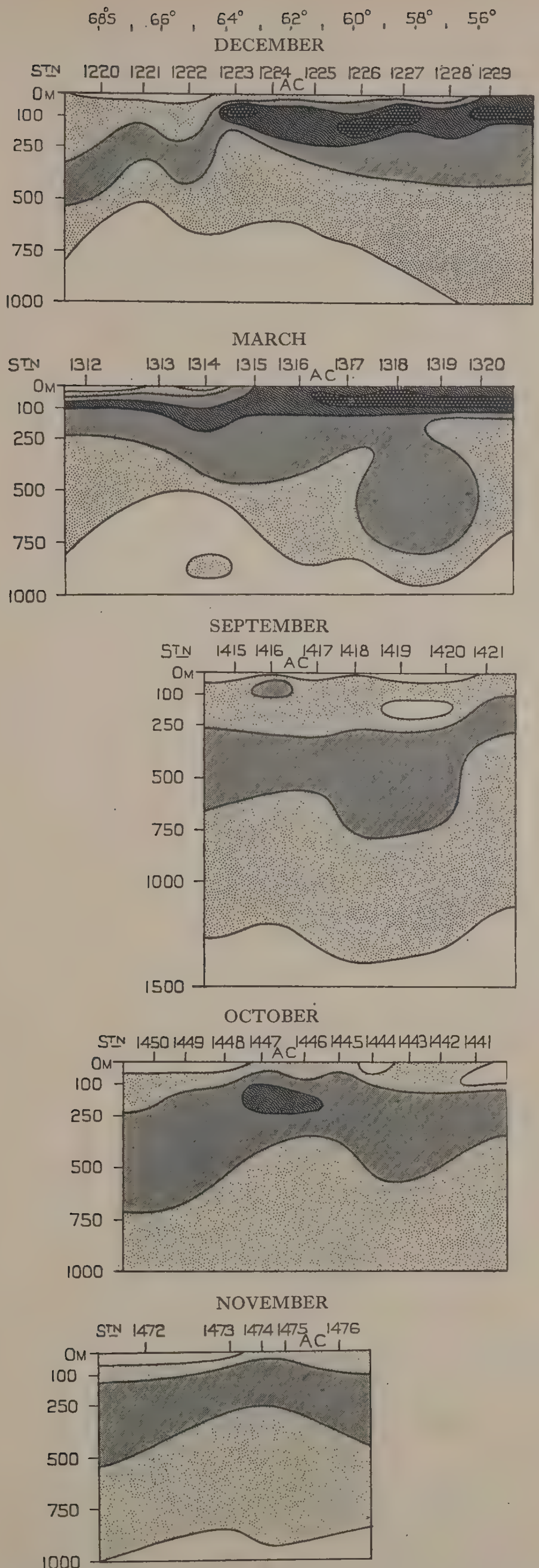


Fig. 6. Vertical distribution of *Eukrohnia hamata* in 80° W.

## Table VI. *Calanus acutus*

Degrees South
69 68 67 66 65 64 63 62 61 60 59 58 57 56 55 54

### DECEMBER

| m. | St. 1220 | 1221 | 1222 | 1223 | 1224 | A ↓ C | 1225 | 1226 | 1227 | 1228 | 1229 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0–50 | 25 | 75 | 0 | **170** | 55 | | 25 | 60 | 10 | 0 | 0 |
| 50–100 | 50 | **165** | 30 | **340** | **480** | | **170** | **130** | 55 | 5 | 0 |
| 100–250 | 90 | **197** | 77 | 43 | 93 | | 37 | 20 | 5 | 0 | 0 |
| 250–500 | **101** | 126 | **105** | 46 | 50 | | 5 | 3 | 2 | 1 | 0 |
| 500–750 | 88 | 41 | 41 | 43 | 14 | | 2 | 3 | 3 | 0 | 0 |
| 750–1000 | 4 | 0 | 48 | 11 | 13 | | 1 | 1 | 3 | 1 | 1 |

### MARCH

| m. | St. 1312 | 1313 | 1314 | 1315 | 1316 | A ↓ C | 1317 | 1318 | 1319 | 1320 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0–50 | 55 | 5 | **275** | 0 | **280** | | 0 | 0 | 0 | 0 |
| 50–100 | **335** | **205** | **140** | 15 | **160** | | 0 | 0 | 0 | 0 |
| 100–250 | 12 | 13 | 35 | 15 | 77 | | 0 | 0 | 0 | 0 |
| 250–500 | 21 | 25 | 3 | 64 | **116** | | 0 | 0 | 0 | 0 |
| 500–750 | 28 | 16 | 8 | 70 | 87 | | 2 | 0 | 0 | 0 |
| 750–1000 | **102** | 23 | 29 | 40 | 52 | | 3 | 0 | 0 | 0 |

### SEPTEMBER

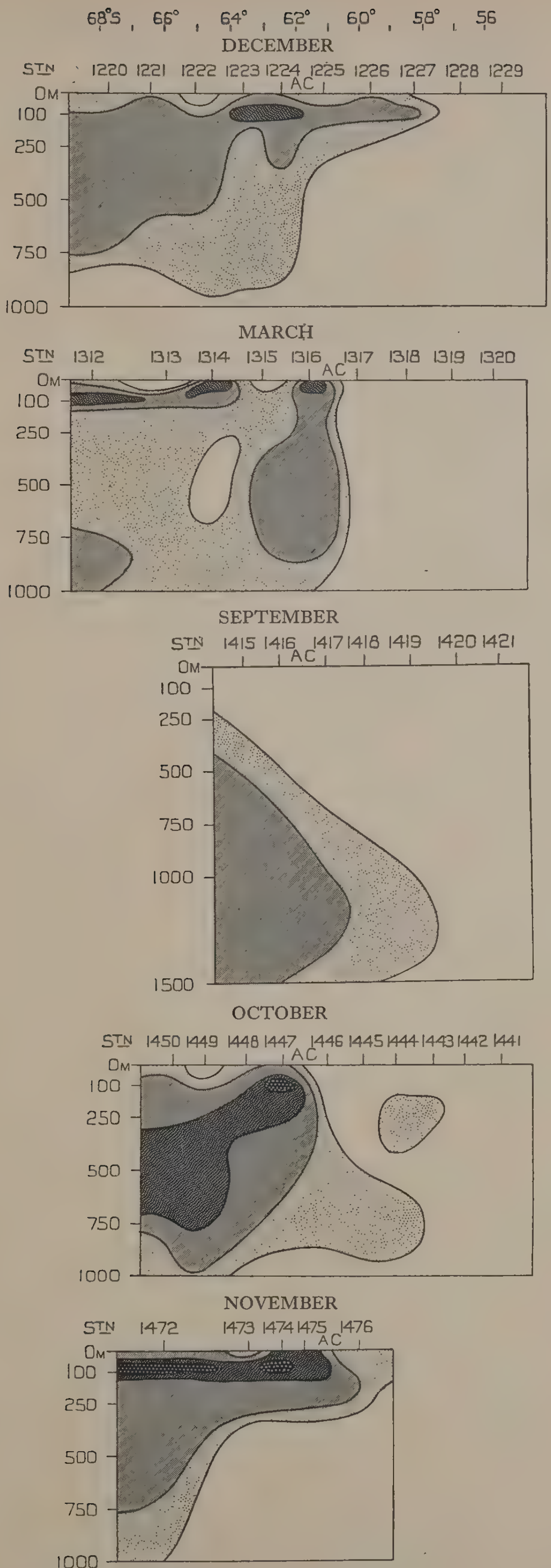
| m. | St. 1415 | 1416 | A ↓ C | 1417 | 1418 | 1419 | 1420 | 1421 |
|---|---|---|---|---|---|---|---|---|
| 0–50 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |
| 50–100 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |
| 100–250 | 2 | 3 | | 0 | 0 | 0 | 0 | 0 |
| 250–500 | 16 | 0 | | 0 | 0 | 0 | 0 | 0 |
| 500–750 | **144** | 40 | | 4 | 0 | 1 | 0 | 0 |
| 750–1000 | **225** | **221** | | 34 | 19 | 0 | 0 | 0 |
| 1000–1500 | **159** | ? | | ? | ? | 12 | ? | 0 |

### OCTOBER

| m. | St. 1450 | 1449 | 1448 | 1447 | A ↓ C | 1446 | 1445 | 1444 | 1443 | 1442 | 1441 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0–50 | 20 | 5 | 45 | 75 | | 0 | ? | 10 | 0 | 5 | 0 |
| 50–100 | **160** | 25 | 90 | **1320** | | 5 | 0 | 0 | 0 | 0 | 0 |
| 100–250 | 70 | **130** | **447** | **520** | | 10 | 5 | 28 | 30 | 0 | 0 |
| 250–500 | **596** | **536** | **208** | 90 | | 42 | 1 | 13 | 1 | 4 | 0 |
| 500–750 | **444** | **480** | 81 | 53 | | 38 | 25 | 29 | 1 | 0 | 2 |
| 750–1000 | 34 | **101** | 14 | 6 | | ? | ? | 14 | 2 | 2 | 1 |

### NOVEMBER

| m. | St. 1472 | 1473 | 1474 | 1475 | A ↓ C | 1476 |
|---|---|---|---|---|---|---|
| 0–50 | **150** | 10 | **265** | **580** | | 20 |
| 50–100 | **1310** | **630** | **855** | **460** | | 25 |
| 100–250 | **198** | **217** | **103** | **107** | | 67 |
| 250–500 | **133** | 4 | 4 | 9 | | 7 |
| 500–750 | 63 | 1 | 0 | 0 | | 4 |
| 750–1000 | 31 | 1 | 1 | 3 | | 0 |



DECEMBER

MARCH

SEPTEMBER

OCTOBER

NOVEMBER

Fig. 7. Vertical distribution of *Calanus acutus* in 80° W.

many ways very similar to that of *Rhincalanus gigas* and to the total macroplankton, though the largest numbers occur perhaps a little farther north in December and March. In December again there is a concentration in the surface layers as far south as 64° S, and beyond this the majority are still in deep water. In March there is the same increase in the surface layer in the higher latitudes, and the same tendency to increase, presumably by sinking, in deep water to the north of the convergence. In September the species is mainly confined to the warm deep water, and the numbers on the whole are rather less than in summer. In October and November it approaches the surface again, and is highest and most abundant near the convergence.

*Rhincalanus gigas* and *Eukrohnia hamata* are typical inhabitants of both the Antarctic and sub-Antarctic zones. The Copepod, *Calanus acutus* (Table VI and Fig. 7), however is a truly Antarctic species which does not extend much to the north of the convergence. In December there is a surface concentration between about 61° and 64° S, and south of 64° there are large numbers in deeper water. *C. acutus* is rather more patchy in its distribution than the others we have so far considered, and the details in the arrangement of the shaded contours in Fig. 7 are not to be relied on. However it is clear that in March the largest numbers are in the Antarctic surface layer at least as far south as the line of stations extends, and there is a strong suggestion of a sinking movement at St. 1316 which is here the most northerly part of the range of distribution of this species. In September the vertical distribution is very clearly defined. It has completely deserted the surface layer and has sunk to a greater depth than either *Rhincalanus gigas* or *Eukrohnia hamata*. The largest numbers occur between 750 and 1000 m., and there are plenty below 1000 m. There is no obvious reduction in the total numbers for this month. Increased numbers were taken in spring however. Like the other species *Calanus acutus* first regains the surface immediately south of the Antarctic convergence in October, and in November it appears to have regained the summer level. In the latter month indeed it seems to have reached a more advanced stage than in the previous December.

These three species then, which together probably constitute much more than half the total mass of living matter in the plankton west of the Drake Strait, clearly spent the summer near the surface and the winter in deep water, at least in the year 1934.

*Pleuromamma robusta* is less common than the three species discussed above, and its vertical distribution is quite different. It normally inhabits deeper water and unlike the other three it undergoes extensive daily vertical migrations. For this reason I have not attempted to represent its distribution by shaded contours. Table VII shows however that in December it was absent from the surface layer and occurred almost exclusively between depths of 250 and 750 m. In December the even numbered stations (1224, etc.) were those taken at night, and it is interesting to note that even in this deep water, to which hardly a vestige of light can penetrate, there is an obvious upward movement of this species at night and withdrawal in daytime. In March there is an astonishing range of vertical migration. At night (again the even numbered stations) the largest catches are at 100–50 m., but in daytime at 750–500 m. In September there is no indication whatever of a general descent into deep water. The species approaches the

## Table VII. *Pleuromamma robusta*

Degrees South 69 68 67 66 65 64 63 62 61 60 59 58 57 56 55 54

DECEMBER

| m. | St. 1220 | 1221 | 1222 | 1223 | 1224 | ↓ A C | 1225 | 1226 | 1227 | 1228 | 1229 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0–50 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |
| 50–100 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |
| 100–250 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |
| 250–500 | 1 | 0 | 0 | 0 | 17 | | 0 | 49 | 12 | 22 | 5 |
| 500–750 | 1 | 1 | 0 | 4 | 32 | | 40 | 13 | 33 | 21 | 47 |
| 750–1000 | 0 | 0 | 0 | 0 | 2 | | 0 | 0 | 0 | 1 | 1 |

MARCH

| m. | St. 1312 | 1313 | 1314 | 1315 | 1316 | ↓ A C | 1317 | 1318 | 1319 | 1320 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0–50 | 0 | 0 | 0 | 0 | 0 | | 0 | 80 | 0 | 0 |
| 50–100 | 0 | 0 | 5 | 0 | 45 | | 0 | 120 | 0 | 185 |
| 100–250 | 0 | 0 | 0 | 0 | 8 | | 2 | 10 | 0 | 10 |
| 250–500 | 0 | 0 | 0 | 1 | 1 | | 8 | 0 | 6 | 1 |
| 500–750 | 0 | 0 | 1 | 10 | 3 | | 16 | 9 | 27 | 8 |
| 750–1000 | 0 | 0 | 0 | 0 | 0 | | 0 | 1 | 0 | 0 |

SEPTEMBER

| m. | St. 1415 | 1416 | ↓ A C | 1417 | 1418 | 1419 | 1420 | 1421 |
|---|---|---|---|---|---|---|---|---|
| 0–50 | 25 | 0 | | 5 | 0 | 0 | 0 | 0 |
| 50–100 | 70 | 0 | | 0 | 0 | 0 | 0 | 10 |
| 100–250 | 73 | 3 | | 10 | 0 | 3 | 0 | 9 |
| 250–500 | 0 | 16 | | 70 | 2 | 32 | 2 | 5 |
| 500–750 | 10 | 24 | | 12 | 44 | 0 | 31 | 8 |
| 750–1000 | 0 | 0 | | 0 | 2 | 4 | 0 | 0 |
| 1000–1500 | 0 | ? | | ? | ? | 0 | ? | 0 |

OCTOBER

| m. | St. 1450 | 1449 | 1448 | 1447 | ↓ A C | 1446 | 1445 | 1444 | 1443 | 1442 | 1441 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0–50 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 |
| 50–100 | 5 | 0 | 0 | 0 | | 30 | 0 | 0 | 0 | 0 | 0 |
| 100–250 | 8 | 2 | 15 | 0 | | 40 | 0 | 57 | 0 | 2 | 0 |
| 250–500 | 1 | 1 | 9 | 20 | | 6 | 0 | 7 | 0 | 23 | 0 |
| 500–750 | 2 | 10 | 4 | 110 | | 33 | 47 | 16 | 20 | 4 | 40 |
| 750–1000 | 0 | 0 | 1 | 0 | | ? | ? | 3 | 1 | 0 | 6 |

NOVEMBER

| m. | St. 1472 | 1473 | 1474 | 1475 | ↓ A C | 1476 |
|---|---|---|---|---|---|---|
| 0–50 | 0 | 0 | 0 | 0 | | 0 |
| 50–100 | 0 | 5 | 5 | 0 | | 0 |
| 100–250 | 7 | 20 | 0 | 60 | | 0 |
| 250–500 | 4 | 29 | 6 | 38 | | 1 |
| 500–750 | 8 | 10 | 23 | 19 | | 63 |
| 750–1000 | 0 | 1 | 1 | 2 | | 0 |

surface at night and descends during the day, and its distribution in October and November is much the same. This species is mostly to the north of the Antarctic convergence in December and March, but in September, October and November it extends farther south.

*Sagitta maxima* rarely enters the surface layers. Table VIII shows that in summer (December and March) it is commonest at 250–100 m., in September it is a little deeper and in spring it approaches the December level.

*S. gazellae* (Table IX) a conspicuous Chaetognath in the Antarctic macroplankton, shows no definite tendency to descend into deep water in winter. It occurs near the surface in each month except November, and even here it might have been found in the upper layers if the stations had been extended a little farther north.

*S. planctonis* (Table X) like *S. maxima* does not enter much into the surface layers. It shows a distinct descent in September, no specimen being taken at less than 500 m. The distribution in October and November is intermediate between that of September and December.

*S. maxima* and *S. gazellae* occur rather more frequently on the north side of the convergence, but *S. planctonis* is commoner to the south.

The small Siphonophore, *Dimophyes arctica*, resembles *Sagitta maxima* in living in summer at about 250–100 m. and descending a little in winter (Table XI).

*Parathemisto gaudichaudi* (Table XII) is nearly always between the surface and 250 m. and although occasional specimens are taken in deeper water we have no evidence of an annual vertical migration. The adults were mostly taken in December, March and September, and the young forms predominated in spring.

*Conchoecia hettacra* (Table XIII) is another species exhibiting daily vertical migrations. The small numbers that were taken suggest that it may reach higher levels in March than in other months, but none was taken in September, and the question of an annual migration must be left open.

*Primno macropa* (Table XIV) does not show any very definite grouping in its vertical distribution. It is very scarce in winter, and there is nothing to suggest that it descends into deeper water at that time of year. The few adults taken in March however were in deep water, and the younger forms in this month occurred at all depths.

*Eukrohnia hamata* f. *antarctica* (Table XV) is a normal inhabitant of deep water. It very rarely appears in the Antarctic surface water but it seems to lie a little deeper in September than in other months.

*Haloptilus oxycephalus* (Table XVI) was scattered irregularly in depth and latitude, and no definite conclusions can be drawn.

*Calanus propinquus* (Table XVII) was very scarce in 80° W in comparison with its abundance in some other parts of the Antarctic, and the figures here are not perhaps very valuable. It lives mainly in the upper layers and there is no suggestion of a descent in winter. In September indeed it was taken only at the ice edge and in the Antarctic surface layer, and it may be mentioned that it was taken here also in moderate numbers in the oblique nets.

## Table VIII. *Sagitta maxima*

Degrees South
69 68 67 66 65 64 63 62 61 60 59 58 57 56 55 54

DECEMBER

| 0 m. | St. 1220 | 1221 | 1222 | 1223 | 1224 | ↓ A C | 1225 | 1226 | 1227 | 1228 | 1229 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 50 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |
| 100 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | **20** | 0 | **90** |
| 250 | 0 | 0 | 0 | 8 | 0 | | **32** | **37** | **43** | **48** | **62** |
| 500 | 0 | 0 | 1 | 1 | 4 | | **10** | 4 | 4 | **15** | 1 |
| 750 | 0 | 1 | 1 | 1 | 1 | | 2 | 3 | 0 | 0 | 3 |
| 1000 | 0 | 0 | 0 | 0 | 1 | | 2 | 0 | 2 | 1 | 0 |

MARCH

| 0 m. | St. 1312 | 1313 | 1314 | 1315 | 1316 | ↓ A C | 1317 | 1318 | 1319 | 1320 |
|---|---|---|---|---|---|---|---|---|---|---|
| 50 | 0 | ? | ? | 0 | 0 | | 0 | 0 | 0 | 0 |
| 100 | 0 | 0 | ? | ? | 0 | | 0 | 0 | 0 | 0 |
| 250 | 7 | 2 | **15** | **25** | **33** | | **75** | **102** | **65** | **30** |
| 500 | 1 | 3 | **14** | 3 | 3 | | 5 | **27** | **25** | **12** |
| 750 | 0 | 0 | 0 | 2 | 1 | | 0 | 0 | 6 | 1 |
| 1000 | 2 | 1 | 1 | 1 | 2 | | 1 | 1 | 4 | 0 |

SEPTEMBER

| 0 m. | St. 1415 | 1416 | ↓ A C | 1417 | 1418 | 1419 | 1420 | 1421 |
|---|---|---|---|---|---|---|---|---|
| 50 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |
| 100 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |
| 250 | 0 | 0 | | 0 | 0 | 0 | 0 | **37** |
| 500 | **10** | **12** | | 6 | 6 | **18** | **14** | 5 |
| 750 | 4 | 3 | | 7 | 7 | 3 | **12** | 6 |
| 1000 | 1 | 2 | | 3 | 0 | 2 | 0 | 1 |
| 1500 | 0 | ? | | ? | ? | 1 | ? | 0 |

OCTOBER

| 0 m. | St. 1450 | 1449 | 1448 | 1447 | ↓ A C | 1446 | 1445 | 1444 | 1443 | 1442 | 1441 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 50 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 |
| 100 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 |
| 250 | 0 | 0 | 2 | 2 | | 0 | **30** | 3 | **32** | **30** | **15** |
| 500 | 8 | **11** | **19** | 7 | | 4 | 6 | **14** | **13** | **12** | **13** |
| 750 | 1 | 0 | 0 | 2 | | 6 | 6 | 6 | 3 | 4 | 1 |
| 1000 | 1 | 0 | 0 | 0 | | ? | ? | 2 | 2 | 1 | 1 |

NOVEMBER

| 0 m. | St. 1472 | 1473 | 1474 | 1475 | ↓ A C | 1476 |
|---|---|---|---|---|---|---|
| 50 | 0 | 0 | 0 | 0 | | 0 |
| 100 | 0 | 0 | 0 | 0 | | 0 |
| 250 | 0 | **13** | 5 | 5 | | 3 |
| 500 | **12** | 2 | 2 | 6 | | **12** |
| 750 | 0 | 2 | 0 | 0 | | 1 |
| 1000 | 0 | 0 | 2 | 0 | | 0 |

## Table IX. *Sagitta gazellae*

Degrees South
69 68 67 66 65 64 63 62 61 60 59 58 57 56 55 54

### DECEMBER

| o m. | St. 1220 | 1221 | 1222 | 1223 | 1224 | ↓ A C | 1225 | 1226 | 1227 | 1228 | 1229 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 50 | 0 | 0 | 0 | 0 | 5 |  | 0 | 25 | 15 | 15 | 30 |
| 100 | 0 | 0 | 5 | 15 | 0 |  | 65 | 80 | 65 | 70 | 20 |
| 250 | 7 | 3 | 5 | 3 | 27 |  | 13 | 8 | 3 | 45 | 10 |
| 500 | 3 | 1 | 2 | 2 | 2 |  | 0 | 0 | 0 | 3 | 1 |
| 750 | 0 | 2 | 0 | 0 | 0 |  | 0 | 0 | 0 | 0 | 0 |
| 1000 | 0 | 0 | 0 | 0 | 0 |  | 0 | 5 | 0 | 0 | 0 |

### MARCH

| o m. | St. 1312 | 1313 | 1314 | 1315 | 1316 | ↓ A C | 1317 | 1318 | 1319 | 1320 |
|---|---|---|---|---|---|---|---|---|---|---|
| 50 | 0 | 0 | 5 | 25 | 20 |  | 15 | 40 | 30 | 30 |
| 100 | 5 | 0 | 5 | 15 | 15 |  | 20 | 85 | 45 | 60 |
| 250 | 0 | 3 | 8 | 5 | 8 |  | 3 | 12 | 10 | 15 |
| 500 | 4 | 1 | 4 | 1 | 1 |  | 1 | 2 | 2 | 0 |
| 750 | 0 | 1 | 0 | 0 | 0 |  | 0 | 10 | 1 | 0 |
| 1000 | 2 | 0 | 0 | 1 | 0 |  | 0 | 0 | 2 | 0 |

### SEPTEMBER

| o m. | St. 1415 | 1416 | ↓ A C | 1417 | 1418 | 1419 | 1420 | 1421 |
|---|---|---|---|---|---|---|---|---|
| 50 | 0 | 5 |  | 15 | 0 | 25 | 5 | 30 |
| 100 | 0 | 0 |  | 0 | 5 | 20 | 5 | 20 |
| 250 | 0 | 0 |  | 8 | 3 | 18 | 10 | 5 |
| 500 | 2 | 3 |  | 4 | 4 | 4 | 16 | 0 |
| 750 | 0 | 0 |  | 2 | 0 | 0 | 0 | 0 |
| 1000 | 0 | 0 |  | 2 | 0 | 0 | 0 | 1 |
| 1500 | 0 | ? |  | ? | ? | 1 | ? | 0 |

### OCTOBER

| o m. | St. 1450 | 1449 | 1448 | 1447 | ↓ A C | 1446 | 1445 | 1444 | 1443 | 1442 | 1441 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 50 | 0 | 0 | 0 | 0 |  | 30 | 10 | 5 | 20 | 0 | 20 |
| 100 | 0 | 0 | 0 | 5 |  | 20 | 5 | 5 | 25 | 30 | 15 |
| 250 | 8 | 7 | 5 | 2 |  | 18 | 10 | 22 | 23 | 12 | 8 |
| 500 | 0 | 4 | 2 | 1 |  | 2 | 0 | 0 | 0 | 2 | 0 |
| 750 | 0 | 0 | 1 | 0 |  | 0 | 1 | 0 | 0 | 0 | 0 |
| 1000 | 0 | 0 | 0 | 1 |  | 1 | ? | 1 | 0 | 0 | 0 |

### NOVEMBER

| o m. | St. 1472 | 1473 | 1474 | 1475 | ↓ A C | 1476 |
|---|---|---|---|---|---|---|
| 50 | 0 | 0 | 0 | 0 |  | 0 |
| 100 | 0 | 0 | 0 | 0 |  | 0 |
| 250 | 0 | 13 | 5 | 5 |  | 3 |
| 500 | 12 | 2 | 2 | 6 |  | 12 |
| 750 | 0 | 2 | 0 | 0 |  | 1 |
| 1000 | 0 | 0 | 2 | 0 |  | 0 |

## Table X. *Sagitta planctonis*

Degrees South 69 68 67 66 65 64 63 62 61 60 59 58 57 56 55 54

DECEMBER

| m. | St. 1220 | 1221 | 1222 | 1223 | 1224 | ↓ A C | 1225 | 1226 | 1227 | 1228 | 1229 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0–50 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 5 | 0 | 0 |
| 50–100 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 5 | 0 | 0 |
| 100–250 | 5 | 3 | 0 | 5 | 5 | | 0 | 3 | 2 | 0 | 0 |
| 250–500 | 7 | 5 | 6 | 8 | 5 | | 10 | 7 | 4 | 0 | 0 |
| 500–750 | 11 | 4 | 10 | 0 | 0 | | 2 | 0 | 1 | 2 | 3 |
| 750–1000 | 0 | 0 | 6 | 0 | 2 | | 2 | 0 | 1 | 1 | 0 |

MARCH

| m. | St. 1312 | 1313 | 1314 | 1315 | 1316 | ↓ A C | 1317 | 1318 | 1319 | 1320 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0–50 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 |
| 50–100 | 0 | 5 | 10 | 0 | 0 | | 0 | 0 | 0 | 0 |
| 100–250 | 5 | 3 | 0 | 2 | 0 | | 0 | 0 | 0 | 0 |
| 250–500 | 6 | 12 | 14 | 1 | 3 | | 0 | 1 | 0 | 0 |
| 500–750 | 0 | 1 | 14 | 1 | 2 | | 2 | 3 | 0 | 2 |
| 750–1000 | 0 | 0 | 0 | 0 | 0 | | 2 | 1 | 0 | 0 |

SEPTEMBER

| m. | St. 1415 | 1416 | ↓ A C | 1417 | 1418 | 1419 | 1420 | 1421 |
|---|---|---|---|---|---|---|---|---|
| 0–50 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |
| 50–100 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |
| 100–250 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |
| 250–500 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |
| 500–750 | 5 | 4 | | 3 | 3 | 1 | 1 | 1 |
| 750–1000 | 0 | 2 | | 2 | 0 | 2 | 0 | 2 |
| 1000–1500 | 3 | ? | | ? | ? | 3 | ? | 1 |

OCTOBER

| m. | St. 1450 | 1449 | 1448 | 1447 | ↓ A C | 1446 | 1445 | 1444 | 1443 | 1442 | 1441 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0–50 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 |
| 50–100 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 |
| 100–250 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 |
| 250–500 | 5 | 0 | 9 | 5 | | 4 | 7 | 5 | 2 | 1 | 1 |
| 500–750 | 14 | 14 | 6 | 4 | | 1 | 3 | 2 | 5 | 3 | 3 |
| 750–1000 | 10 | 6 | 3 | 3 | | ? | ? | 1 | 2 | 1 | 0 |

NOVEMBER

| m. | St. 1472 | 1473 | 1474 | 1475 | ↓ A C | 1476 |
|---|---|---|---|---|---|---|
| 0–50 | 0 | 0 | 0 | 0 | | 0 |
| 50–100 | 0 | 0 | 0 | 0 | | 0 |
| 100–250 | 0 | 0 | 0 | 0 | | 3 |
| 250–500 | 4 | 7 | 6 | 8 | | 7 |
| 500–750 | 4 | 1 | 0 | 1 | | 2 |
| 750–1000 | 2 | 0 | 0 | 2 | | 1 |

## Table XI. *Dimophyes arctica*

Degrees South: 69 68 67 66 65 64 63 62 61 60 59 58 57 56 55 54

DECEMBER

| m. | St. 1220 | 1221 | 1222 | 1223 | 1224 | ↓ A C | 1225 | 1226 | 1227 | 1228 | 1229 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0–50 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 5 |
| 50–100 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 50 |
| 100–250 | 8 | 12 | 8 | 0 | 0 | | 3 | 3 | 3 | 12 | 30 |
| 250–500 | 0 | 0 | 1 | 0 | 1 | | 5 | 1 | 1 | 7 | 3 |
| 500–750 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |
| 750–1000 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |

MARCH

| m. | St. 1312 | 1313 | 1314 | 1315 | 1316 | ↓ A C | 1317 | 1318 | 1319 | 1320 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0–50 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 |
| 50–100 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 30 |
| 100–250 | 0 | 0 | 7 | 3 | 5 | | 12 | 15 | 27 | 32 |
| 250–500 | 4 | 3 | 3 | 1 | 2 | | 0 | 7 | 1 | 10 |
| 500–750 | 1 | 1 | 1 | 0 | 0 | | 0 | 1 | 0 | 0 |
| 750–1000 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 |

SEPTEMBER

| m. | St. 1415 | 1416 | ↓ A C | 1417 | 1418 | 1419 | 1420 | 1421 |
|---|---|---|---|---|---|---|---|---|
| 0–50 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |
| 50–100 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |
| 100–250 | 0 | 0 | | 0 | 0 | 0 | 0 | 5 |
| 250–500 | 1 | 0 | | 0 | 0 | 1 | 1 | 7 |
| 500–750 | 0 | 2 | | 0 | 4 | 0 | 1 | 0 |
| 750–1000 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |
| 1000–1500 | 0 | ? | | ? | ? | 0 | 0 | 0 |

OCTOBER

| m. | St. 1450 | 1449 | 1448 | 1447 | ↓ A C | 1446 | 1445 | 1444 | 1443 | 1442 | 1441 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0–50 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 |
| 50–100 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 |
| 100–250 | 5 | 8 | 3 | 0 | | 12 | 5 | 0 | 3 | 5 | 7 |
| 250–500 | 0 | 2 | 0 | 1 | | 0 | 4 | 0 | 4 | 3 | 1 |
| 500–750 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 2 |
| 750–1000 | 0 | 0 | 0 | 0 | | ? | ? | 0 | 0 | 0 | 0 |

NOVEMBER

| m. | St. 1472 | 1473 | 1474 | 1475 | ↓ A C | 1476 |
|---|---|---|---|---|---|---|
| 0–50 | 0 | 0 | 0 | 0 | | 5 |
| 50–100 | 0 | 0 | 0 | 0 | | 0 |
| 100–250 | 5 | 3 | 0 | 0 | | 5 |
| 250–500 | 0 | 0 | 0 | 2 | | 3 |
| 500–750 | 0 | 0 | 0 | 0 | | 0 |
| 750–1000 | 0 | 0 | 0 | 0 | | 0 |

## Table XII. *Parathemisto gaudichaudi*

Degrees South
69 68 67 66 65 64 63 62 61 60 59 58 57 56 55 54

DECEMBER

| 0 m. | St. 1220 | 1221 | 1222 | 1223 | 1224 | ↓ A C | 1225 | 1226 | 1227 | 1228 | 1229 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 50 | 0 | 0 | 0 | 0 | **20** | | **20** | **30** | **35** | 0 | 5 |
| 100 | 0 | 0 | 0 | 0 | 0 | | 5 | 0 | 15 | 0 | 10 |
| 250 | 0 | 0 | 0 | 0 | 0 | | 5 | 0 | **20** | 2 | 0 |
| 500 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 2 | 1 |
| 750 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 3 | 0 |
| 1000 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |

MARCH

| 0 m. | St. 1312 | 1313 | 1314 | 1315 | 1316 | ↓ A C | 1317 | 1318 | 1319 | 1320 |
|---|---|---|---|---|---|---|---|---|---|---|
| 50 | 0 | 5 | 0 | 0 | **165** | | 0 | 0 | 0 | 0 |
| 100 | 0 | 0 | 5 | 5 | 0 | | 10 | 0 | 0 | 5 |
| 250 | 0 | 0 | 2 | 2 | 2 | | 0 | 0 | 0 | 0 |
| 500 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 |
| 750 | 0 | 0 | 0 | 0 | 0 | | 0 | 3 | 0 | 0 |
| 1000 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 1 | 0 |

SEPTEMBER

| 0 m. | St. 1415 | 1416 | ↓ A C | 1417 | 1418 | 1419 | 1420 | 1421 |
|---|---|---|---|---|---|---|---|---|
| 50 | 5 | 0 | | 0 | 0 | 5 | 0 | 0 |
| 100 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |
| 250 | 0 | 0 | | 2 | 0 | 0 | 0 | 0 |
| 500 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |
| 750 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |
| 1000 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |
| 1500 | 0 | ? | | ? | ? | 0 | ? | 0 |

OCTOBER

| 0 m. | St. 1450 | 1449 | 1448 | 1447 | ↓ A C | 1446 | 1445 | 1444 | 1443 | 1442 | 1441 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 50 | 0 | 0 | 0 | 0 | | **750** | 0 | **45** | 0 | 10 | 0 |
| 100 | 0 | 0 | 0 | 0 | | 10 | **20** | 5 | 5 | 5 | 5 |
| 250 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 |
| 500 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 |
| 750 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 |
| 1000 | 0 | 0 | 0 | 0 | | ? | ? | 0 | 0 | 0 | 0 |

NOVEMBER

| 0 m. | St. 1472 | 1473 | 1474 | 1475 | ↓ A C | 1476 |
|---|---|---|---|---|---|---|
| 50 | 0 | 0 | **45** | **145** | | 0 |
| 100 | 0 | 0 | 15 | 10 | | **30** |
| 250 | 0 | 0 | 0 | 0 | | 0 |
| 500 | 0 | 0 | 0 | 0 | | 0 |
| 750 | 0 | 0 | 0 | 0 | | 0 |
| 1000 | 0 | 0 | 0 | 0 | | 1 |

## Table XIII. *Conchoecia hettacra*

Degrees South 69 68 67 66 65 64 63 62 61 60 59 58 57 56 55 54

DECEMBER

| m. | St. 1220 | 1221 | 1222 | 1223 | 1224 | ↓ A C | 1225 | 1226 | 1227 | 1228 | 1229 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0–50 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |
| 50–100 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |
| 100–250 | 8 | 3 | 12 | 92 | 17 | | 0 | 0 | 0 | 0 | 0 |
| 250–500 | 1 | 0 | 5 | 2 | 0 | | 1 | 3 | 4 | 0 | 0 |
| 500–750 | 2 | 1 | 1 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |
| 750–1000 | 1 | 0 | 1 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |

MARCH

| m. | St. 1312 | 1313 | 1314 | 1315 | 1316 | ↓ A C | 1317 | 1318 | 1319 | 1320 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0–50 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 |
| 50–100 | 0 | 0 | 30 | 0 | 10 | | 0 | 0 | 0 | 0 |
| 100–250 | 0 | 0 | 0 | 0 | 3 | | 0 | 0 | 0 | 0 |
| 250–500 | 0 | 0 | 0 | 1 | 0 | | 0 | 0 | 0 | 0 |
| 500–750 | 0 | 1 | 0 | 3 | 1 | | 0 | 0 | 0 | |
| 750–1000 | 1? | 0 | 0 | 0 | 2 | | 0 | 0 | 0 | 0 |

SEPTEMBER

| m. | St. 1415 | 1416 | ↓ A C | 1417 | 1418 | 1419 | 1420 | 1421 |
|---|---|---|---|---|---|---|---|---|
| 0–50 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |
| 50–100 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |
| 100–250 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |
| 250–500 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |
| 500–750 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |
| 750–1000 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |
| 1000–1500 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |

OCTOBER

| m. | St. 1450 | 1449 | 1448 | 1447 | ↓ A C | 1446 | 1445 | 1444 | 1443 | 1442 | 1441 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0–50 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 |
| 50–100 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 |
| 100–250 | 0 | 2 | 2 | 7 | | 0 | 0 | 0 | 0 | 0 | 0 |
| 250–500 | 3 | 7 | 0 | 1 | | 0 | 0 | 0 | 0 | 0 | 0 |
| 500–750 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 |
| 750–1000 | 0 | 0 | 0 | 0 | | ? | ? | 0 | 0 | 0 | 0 |

NOVEMBER

| m. | St. 1472 | 1473 | 1474 | 1475 | ↓ A C | 1476 |
|---|---|---|---|---|---|---|
| 0–50 | 0 | 0 | 0 | 0 | | 0 |
| 50–100 | 10 | 10 | 0 | 0 | | 0 |
| 100–250 | 13 | 10 | 30 | 2 | | 0 |
| 250–500 | 8 | 6 | 10 | 35 | | 0 |
| 500–750 | 0 | 0 | 0 | 0 | | 1? |
| 750–1000 | 0 | 0 | 0 | 0 | | 0 |

## Table XIV. *Primno macropa*

Degrees South 69 68 67 66 65 64 63 62 61 60 59 58 57 56 55 54

DECEMBER

| m. | St. 1220 | 1221 | 1222 | 1223 | 1224 | ↓ A C | 1225 | 1226 | 1227 | 1228 | 1229 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0–50 | 0 | 0 | 0 | 0 | 0 | | 0 | 10 | 0 | 0 | 15 |
| 50–100 | 0 | 0 | 0 | 10 | 0 | | 10 | 0 | 5 | 5 | 0 |
| 100–250 | 2 | 2 | 2 | 5 | 5 | | 2 | 6 | 6 | 7 | 0 |
| 250–500 | 0 | 0 | 0 | 0 | 1 | | 2 | 6 | 4 | 1 | 1 |
| 500–750 | 0 | 0 | 1 | 0 | 0 | | 3 | 0 | 0 | 2 | 2 |
| 750–1000 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 1 | 4 |

MARCH

| m. | St. 1312 | 1313 | 1314 | 1315 | 1316 | ↓ A C | 1317 | 1318 | 1319 | 1320 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0–50 | 0 | 0 | 0 | 0 | 0 | | 5 | 5 | 0 | 0 |
| 50–100 | 0 | 0 | 0 | 70 | 0 | | 35 | 5 | 95 | 10 |
| 100–250 | 2 | 0 | 0 | 0 | 2 | | 0 | 15 | 0 | 3 |
| 250–500 | 1 | 0 | 1 | 3 | 2 | | 0 | 10 | 1 | 5 |
| 500–750 | 2. | 0 | 2 | 5 | 1 | | 3 | 8 | 4 | 8 |
| 750–1000 | 0 | 0 | 0 | 1 | 0 | | 1 | 7 | 15 | 7 |

SEPTEMBER

| m. | St. 1415 | 1416 | ↓ A C | 1417 | 1418 | 1419 | 1420 | 1421 |
|---|---|---|---|---|---|---|---|---|
| 0–50 | 0 | 0 | | 0 | 0 | 0 | 0 | 15 |
| 50–100 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |
| 100–250 | 0 | 0 | | 0 | 0 | 0 | 0 | 3 |
| 250–500 | 0 | 0 | | 0 | 0 | 0 | 1 | 3 |
| 500–750 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |
| 750–1000 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |
| 1000–1500 | 0 | ? | | ? | ? | 0 | ? | 0 |

OCTOBER

| m. | St. 1450 | 1449 | 1448 | 1447 | ↓ A C | 1446 | 1445 | 1444 | 1443 | 1442 | 1441 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0–50 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 |
| 50–100 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 5 | 0 | 0 |
| 100–250 | 3 | 0 | 3 | 0 | | 6 | 2 | 2 | 2 | 12 | 0 |
| 250–500 | 0 | 0 | 0 | 1 | | 4 | 1 | 1 | 2 | 3 | 2 |
| 500–750 | 0 | 0 | 0 | 1 | | 0 | 0 | 0 | 0 | 0 | 0 |
| 750–1000 | 0 | 0 | 0 | 0 | | ? | ? | 0 | 0 | 0 | 1 |

NOVEMBER

| m. | St. 1472 | 1473 | 1474 | 1475 | ↓ A C | 1476 |
|---|---|---|---|---|---|---|
| 0–50 | 0 | 0 | 0 | 0 | | 0 |
| 50–100 | 0 | 0 | 0 | 0 | | 0 |
| 100–250 | 3 | 0 | 2 | 0 | | 0 |
| 250–500 | 0 | 0 | 0 | 1 | | 4 |
| 500–750 | 0 | 0 | 0 | 1 | | 1 |
| 750–1000 | 0 | 0 | 0 | 0 | | 0 |

## Table XV. *Eukrohnia hamata* f. *antarctica*

Degrees South
69 68 67 66 65 64 63 62 61 60 59 58 57 56 55 54

DECEMBER

| | St. 1220 | 1221 | 1222 | 1223 | 1224 | ↓ A C | 1225 | 1226 | 1227 | 1228 | 1229 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 m. | | | | | | | | | | | |
| 50 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |
| 100 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | | 0 | 2 | 0 | 0 | 0 |
| 250 | | | | | | | | | | | |
| | 0 | 0 | 0 | 1 | 0 | | 0 | 1 | 0 | 0 | 1 |
| 500 | | | | | | | | | | | |
| | 0 | 3 | 0 | 0 | 2 | | 1 | 3 | 7 | 1 | 0 |
| 750 | | | | | | | | | | | |
| | 0 | 0 | 0 | 0 | 3 | | ? | 4 | 0 | 0 | 0 |
| 1000 | | | | | | | | | | | |

MARCH

| | St. 1312 | 1313 | 1314 | 1315 | 1316 | ↓ A C | 1317 | 1318 | 1319 | 1320 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 m. | | | | | | | | | | |
| 50 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 |
| 100 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 2 | 0 | | 0 | 0 | 0 | 0 |
| 250 | | | | | | | | | | |
| | 0 | 0 | 0 | 1 | 0 | | 1 | 0 | 0 | 0 |
| 500 | | | | | | | | | | |
| | 0 | 0 | 1 | 3 | 1 | | 0 | 0 | 0 | 0 |
| 750 | | | | | | | | | | |
| | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 1 |
| 1000 | | | | | | | | | | |

SEPTEMBER

| | St. 1415 | 1416 | ↓ A C | 1417 | 1418 | 1419 | 1420 | 1421 |
|---|---|---|---|---|---|---|---|---|
| 0 m. | | | | | | | | |
| 50 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |
| 100 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |
| 250 | | | | | | | | |
| | 0 | 0 | | 0 | 0 | 1 | 0 | 3 |
| 500 | | | | | | | | |
| | 1 | 0 | | 0 | 1 | 0 | 0 | 2 |
| 750 | | | | | | | | |
| | 0 | 3 | | 7 | 2 | 8 | 9 | 5 |
| 1000 | | | | | | | | |
| | 5 | ? | | ? | ? | 4 | ? | 7 |
| 1500 | | | | | | | | |

OCTOBER

| | St. 1450 | 1449 | 1448 | 1447 | ↓ A C | 1446 | 1445 | 1444 | 1443 | 1442 | 1441 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 m. | | | | | | | | | | | |
| 50 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 |
| 100 | 0 | 0 | 0 | 0 | | 0 | 5 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | | 2 | 0 | 0 | 2 | 0 | 0 |
| 250 | | | | | | | | | | | |
| | 1 | 0 | 0 | 0 | | 0 | 0 | 0 | 2 | 1 | 0 |
| 500 | | | | | | | | | | | |
| | 1 | 0 | 0 | 1 | | 3 | 10 | 5 | 4 | 2 | 2 |
| 750 | | | | | | | | | | | |
| | 1 | 0 | 1 | 6 | | ? | ? | ? | 11 | 2 | 4 |
| 1000 | | | | | | | | | | | |

NOVEMBER

| | St. 1472 | 1473 | 1474 | 1475 | ↓ A C | 1476 |
|---|---|---|---|---|---|---|
| 0 m. | | | | | | |
| 50 | 0 | 0 | 0 | 0 | | 0 |
| 100 | 0 | 0 | 0 | 0 | | 5 |
| | 2 | 0 | 0 | 0 | | 2 |
| 250 | | | | | | |
| | 0 | 0 | 1 | 0 | | 0 |
| 500 | | | | | | |
| | 1 | 2 | 2 | 1 | | 2 |
| 750 | | | | | | |
| | 0 | 5 | 3 | 2 | | 1 |
| 1000 | | | | | | |

## Table XVI. *Haloptilus oxycephalus*

Degrees South 69 68 67 66 65 64 63 62 61 60 59 58 57 56 55 54

DECEMBER

| m. | St. 1220 | 1221 | 1222 | 1223 | 1224 | ↓ A C | 1225 | 1226 | 1227 | 1228 | 1229 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 50 | 0 | 0 | 0 | 0 | 0 |  | 0 | 0 | 0 | 0 | 5 |
| 100 | 0 | 0 | 0 | 0 | 0 |  | 0 | 0 | 0 | 0 | 25 |
| 250 | 2 | 2 | 2 | 0 | 0 |  | 3 | 0 | 2 | 0 | 0 |
| 500 | 1 | 0 | 0 | 0 | 0 |  | 0 | 0 | 0 | 0 | 0 |
| 750 | 0 | 0 | 0 | 0 | 0 |  | 0 | 0 | 0 | 0 | 0 |
| 1000 | 0 | 0 | 0 | 0 | 0 |  | 0 | 0 | 0 | 0 | 0 |

MARCH

| m. | St. 1312 | 1313 | 1314 | 1315 | 1316 | ↓ A C | 1317 | 1318 | 1319 | 1320 |
|---|---|---|---|---|---|---|---|---|---|---|
| 50 | 0 | 0 | 0 | 0 | 0 |  | 0 | 0 | 0 | 0 |
| 100 | 0 | 5 | 5 | 20 | 0 |  | 0 | 0 | 0 | 10 |
| 250 | 5 | 2 | 12 | 0 | 0 |  | 0 | 0 | 0 | 0 |
| 500 | 0 | 0 | 1 | 1 | 1 |  | 0 | 0 | 0 | 1 |
| 750 | 0 | 0 | 0 | 0 | 1 |  | 0 | 0 | 0 | 0 |
| 1000 | 0 | 0 | 0 | 0 | 0 |  | 0 | 0 | 0 | 0 |

SEPTEMBER

| m. | St. 1415 | 1416 | ↓ A C | 1417 | 1418 | 1419 | 1420 | 1421 |
|---|---|---|---|---|---|---|---|---|
| 50 | 0 | 0 |  | 0 | 0 | 0 | 0 | 0 |
| 100 | 0 | 0 |  | 0 | 0 | 0 | 0 | 5 |
| 250 | 0 | 0 |  | 0 | 0 | 0 | 0 | 7 |
| 500 | 0 | 0 |  | 0 | 0 | 0 | 0 | 0 |
| 750 | 0 | 0 |  | 0 | 0 | 0 | 0 | 0 |
| 1000 | 0 | 0 |  | 0 | 0 | 0 | 0 | 0 |
| 1500 | 0 | ? |  | ? | ? | 1? | ? | 0 |

OCTOBER

| m. | St. 1450 | 1449 | 1448 | 1447 | ↓ A C | 1446 | 1445 | 1444 | 1443 | 1442 | 1441 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 50 | 0 | 0 | 0 | 0 |  | 0 | 25 | 0 | 0 | 0 | 0 |
| 100 | 0 | 0 | 0 | 0 |  | 5 | 0 | 0 | 0 | 0 | 0 |
| 250 | 0 | 0 | 2 | 0 |  | 0 | 0 | 0 | 0 | 0 | 0 |
| 500 | 0 | 1 | 0 | 0 |  | 0 | 0 | 9 | 0 | 1 | 0 |
| 750 | 0 | 0 | 0 | 0 |  | 0 | 0 | 3 | 0 | 0 | 3 |
| 1000 | 2 | 1 | 0 | 0 |  | ? | ? | 1 | 3 | 0 | 1 |

SEPTEMBER

| m. | St. 1472 | 1473 | 1474 | 1475 | ↓ A C | 1476 |
|---|---|---|---|---|---|---|
| 50 | 0 | 0 | 0 | 0 |  | 0 |
| 100 | 0 | 0 | 0 | 0 |  | 0 |
| 250 | 0 | 0 | 0 | 0 |  | 0 |
| 500 | 0 | 0 | 0 | 0 |  | 0 |
| 750 | 0 | 0 | 0 | 0 |  | 0 |
| 1000 | 0 | 0 | 0 | 0 |  | 0 |

## Table XVII. *Calanus propinquus (adult)*

Degrees South 69 68 67 66 65 64 63 62 61 60 59 58 57 56 55 54

### DECEMBER

| m. | St. 1220 | 1221 | 1222 | 1223 | 1224 | ↓ A C | 1225 | 1226 | 1227 | 1228 | 1229 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0–50 | 0 | 0 | 0 | 0 | 0 |  | 0 | 0 | 0 | 0 | 0 |
| 50–100 | 5 | 0 | 0 | 0 | 0 |  | 0 | 0 | 0 | 0 | 0 |
| 100–250 | 0 | 7 | 0 | 0 | 0 |  | 2 | 0 | 0 | 0 | 0 |
| 250–500 | 0 | 0 | 0 | 0 | 0 |  | 0 | 0 | 0 | 0 | 0 |
| 500–750 | 0 | 0 | 0 | 0 | 0 |  | 0 | 0 | 0 | 0 | 0 |
| 750–1000 | 0 | 0 | 0 | 0 | 0 |  | 0 | 0 | 0 | 0 | 0 |

### MARCH

| m. | St. 1312 | 1313 | 1314 | 1315 | 1316 | ↓ A C | 1317 | 1318 | 1319 | 1320 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0–50 | 0 | 0 | 0 | 0 | 0 |  | 0 | 0 | 0 | 0 |
| 50–100 | 0 | 0 | 1 | 0 | 0 |  | 0 | 0 | 0 | 0 |
| 100–250 | ? | ? | 0 | 0 | 1 |  | 0 | 0 | 0 | 0 |
| 250–500 | 0 | ? | 1 | 0 | 1 |  | 0 | 0 | 0 | 0 |
| 500–750 | 0 | 0 | 0 | 0 | 0 |  | 0 | 0 | 0 | 0 |
| 750–1000 | 0 | 0 | 0 | 0 | 0 |  | 0 | 0 | 0 | 0 |

### SEPTEMBER

| m. | St. 1415 | 1416 | ↓ A C | 1417 | 1418 | 1419 | 1420 | 1421 |
|---|---|---|---|---|---|---|---|---|
| 0–50 | 25 | 0 |  | 0 | 0 | 0 | 0 | 0 |
| 50–100 | 5 | 0 |  | 0 | 0 | 0 | 0 | 0 |
| 100–250 | 0 | 0 |  | 0 | 0 | 0 | 0 | 0 |
| 250–500 | 0 | 0 |  | 0 | 0 | 0 | 0 | 0 |
| 500–750 | 0 | 0 |  | 0 | 0 | 0 | 0 | 0 |
| 750–1000 | 0 | 0 |  | 0 | 0 | 0 | 0 | 0 |
| 1000–1500 | 0 | ? |  | ? | ? | 0 | ? | 0 |

### OCTOBER

| m. | St. 1450 | 1449 | 1448 | 1447 | ↓ A C | 1446 | 1445 | 1444 | 1443 | 1442 | 1441 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0–50 | 25 | 0 | 5 | 0 |  | 0 | 0 | 0 | 0 | 0 | 0 |
| 50–100 | 30 | 0 | 0 | 0 |  | 0 | 0 | 0 | 0 | 0 | 0 |
| 100–250 | 2 | 0 | 0 | 0 |  | 0 | 0 | 0 | 0 | 0 | 0 |
| 250–500 | 1 | 0 | 0 | 0 |  | 0 | 0 | 0 | 0 | 0 | 0 |
| 500–750 | 0 | 1 | 0 | 0 |  | 0 | 0 | 0 | 0 | 0 | 0 |
| 750–1000 | 0 | 0 | 0 | 0 |  | 0 | 0 | 0 | 0 | 0 | 0 |

### NOVEMBER

| m. | St. 1472 | 1473 | 1474 | 1475 | ↓ A C | 1476 |
|---|---|---|---|---|---|---|
| 0–50 | 0 | 0 | 0 | 0 |  | 0 |
| 50–100 | 10 | 0 | 0 | 0 |  | 0 |
| 100–250 | 3 | 0 | 0 | 0 |  | 0 |
| 250–500 | 0 | 0 | 0 | 0 |  | 0 |
| 500–750 | 0 | 0 | 0 | 0 |  | 0 |
| 750–1000 | 0 | 0 | 0 | 0 |  | 0 |

## Table XVIII. *Euphausia triacantha*

Degrees South
69 68 67 66 65 64 63 62 61 60 59 58 57 56 55 54

DECEMBER

| | St. 1220 | 1221 | 1222 | 1223 | 1224 | ↓ A C | 1225 | 1226 | 1227 | 1228 | 1229 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 50 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |
| 100 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |
| 250 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |
| 500 | 0 | 0 | 2 | 0 | 2 | | 3 | 0 | 1 | 0 | 0 |
| 750 | 0 | 0 | 0 | 0 | 0 | | 1 | 0 | 0 | 0 | 0 |
| 1000 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |

MARCH

| | St. 1312 | 1313 | 1314 | 1315 | 1316 | ↓ A C | 1317 | 1318 | 1319 | 1320 |
|---|---|---|---|---|---|---|---|---|---|---|
| 50 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 |
| 100 | 0 | 0 | 5 | 0 | 0 | | 0 | 5 | 0 | 0 |
| 250 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 |
| 500 | 1 | 1 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 |
| 750 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 |
| 1000 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 |

SEPTEMBER

| | St. 1415 | 1416 | ↓ A C | 1417 | 1418 | 1419 | 1420 | 1421 |
|---|---|---|---|---|---|---|---|---|
| 50 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |
| 100 | 0 | 0 | | 0 | 0 | 5 | 0 | 0 |
| 250 | 0 | 0 | | 2 | 0 | 0 | 0 | 0 |
| 500 | 1 | 0 | | 0 | 0 | 0 | 0 | 0 |
| 750 | 0 | 2 | | 0 | 0 | 0 | 0 | 0 |
| 1000 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |
| 1500 | 0 | ? | | ? | ? | 0 | ? | 0 |

OCTOBER

| | St. 1450 | 1449 | 1448 | 1447 | ↓ A C | 1446 | 1445 | 1444 | 1443 | 1442 | 1441 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 50 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 |
| 100 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 |
| 250 | 0 | 0 | 0 | 0 | | 0 | 0 | 2 | 0 | 0 | 0 |
| 500 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 |
| 750 | 0 | 0 | 0 | 1 | | 0 | 4 | 0 | 0 | 1 | 0 |
| 1000 | 0 | 0 | 0 | 0 | | 0 | ? | 0 | 0 | 0 | 0 |

NOVEMBER

| | St. 1472 | 1473 | 1474 | 1475 | ↓ A C | 1476 |
|---|---|---|---|---|---|---|
| 50 | 0 | 0 | 0 | 0 | | 0 |
| 100 | 0 | 0 | 0 | 0 | | 0 |
| 250 | 2 | 0 | 0 | 3 | | 0 |
| 500 | 0 | 0 | 0 | 0 | | 0 |
| 750 | 0 | 0 | 0 | 0 | | 0 |
| 1000 | 0 | 0 | 0 | 0 | | 0 |

# Table XIX. *Euphausia vallentini*

Degrees South 69 68 67 66 65 64 63 62 61 60 59 58 57 56 55 54

DECEMBER

| m. | St. 1220 | 1221 | 1222 | 1223 | 1224 | ↓ A C | 1225 | 1226 | 1227 | 1228 | 1229 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0–50 | 0 | 0 | 0 | 0 | 0 |  | 0 | 0 | 0 | 0 | 0 |
| 50–100 | 0 | 0 | 0 | 0 | 0 |  | 0 | 0 | 0 | 0 | 0 |
| 100–250 | 0 | 0 | 0 | 0 | 0 |  | 0 | 0 | 0 | 0 | 0 |
| 250–500 | 0 | 0 | 0 | 0 | 0 |  | 0 | 0 | 1 | 0 | 0 |
| 500–750 | 0 | 0 | 0 | 0 | 0 |  | 0 | 0 | 0 | 0 | 0 |
| 750–1000 | 0 | 0 | 0 | 0 | 0 |  | 0 | 0 | 0 | 0 | 0 |

MARCH

| m. | St. 1312 | 1313 | 1314 | 1315 | 1316 | ↓ A C | 1317 | 1318 | 1319 | 1320 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0–50 | 0 | 0 | 0 | 0 | 0 |  | 0 | 5 | 0 | 20 |
| 50–100 | 0 | 0 | 0 | 0 | 0 |  | 0 | 35 | 0 | 0 |
| 100–250 | 0 | 0 | 0 | 0 | 0 |  | 0 | 0 | 0 | 0 |
| 250–500 | 0 | 0 | 0 | 0 | 0 |  | 0 | 0 | 1? | 0 |
| 500–750 | 0 | 0 | 0 | 0 | 0 |  | 1 | 0 | 7 | 0 |
| 750–1000 | 0 | 0 | 0 | 0 | 0 |  | 0 | 0 | 0 | 0 |

SEPTEMBER

| m. | St. 1415 | 1416 | ↓ A C | 1417 | 1418 | 1419 | 1420 | 1421 |
|---|---|---|---|---|---|---|---|---|
| 0–50 | 0 | 0 |  | 0 | 0 | 0 | 0 | 0 |
| 50–100 | 0 | 0 |  | 0 | 0 | 0 | 0 | 0 |
| 100–250 | 0 | 0 |  | 0 | 0 | 2 | 0 | 0 |
| 250–500 | 0 | 0 |  | 0 | 0 | 0 | 0 | 0 |
| 500–750 | 0 | 0 |  | 0 | 0 | 0 | 0 | 0 |
| 750–1000 | 0 | 0 |  | 0 | 0 | 0 | 0 | 0 |
| 1000–1500 | 0 | ? |  | ? | ? | 0 | ? | 0 |

OCTOBER

| m. | St. 1450 | 1449 | 1448 | 1447 | ↓ A C | 1446 | 1445 | 1444 | 1443 | 1442 | 1441 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0–50 | 0 | 0 | 0 | 0 |  | 0 | 0 | 0 | 0 | 0 | 0 |
| 50–100 | 0 | 0 | 0 | 0 |  | 0 | 0 | 0 | 0 | 0 | 0 |
| 100–250 | 0 | 0 | 0 | 0 |  | 0 | 0 | 0 | 0 | 0 | 0 |
| 250–500 | 0 | 0 | 0 | 0 |  | 0 | 0 | 0 | 0 | 0 | 0 |
| 500–750 | 0 | 0 | 0 | 0 |  | 0 | 1 | 0 | 2 | 0 | 2 |
| 750–1000 | 0 | 0 | 0 | 0 |  | 0 | ? | 0 | 0 | 0 | 0 |

NOVEMBER

| m. | St. 1472 | 1473 | 1474 | 1475 | ↓ A C | 1476 |
|---|---|---|---|---|---|---|
| 0–50 | 0 | 0 | 0 | 0 |  | 0 |
| 50–100 | 0 | 0 | 0 | 0 |  | 0 |
| 100–250 | 0 | 0 | 0 | 0 |  | 0 |
| 250–500 | 0 | 0 | 0 | 0 |  | 0 |
| 500–750 | 0 | 0 | 0 | 0 |  | 0 |
| 750–1000 | 0 | 0 | 0 | 0 |  | 0 |

## Table XX. *Euphausia frigida*

Degrees South 69 68 67 66 65 64 63 62 61 60 59 58 57 56 55 54

### DECEMBER

| m. | St. 1220 | 1221 | 1222 | 1223 | 1224 | ↓ A C | 1225 | 1226 | 1227 | 1228 | 1229 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 50 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |
| 100 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |
| 250 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |
| 500 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |
| 750 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | |
| 1000 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |

### MARCH

| m. | St. 1312 | 1313 | 1314 | 1315 | 1316 | ↓ A C | 1317 | 1318 | 1319 | 1320 |
|---|---|---|---|---|---|---|---|---|---|---|
| 50 | 0 | 0 | 35 | 0 | 0 | | 0 | 0 | 0 | 0 |
| 100 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 |
| 250 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 |
| 500 | 0 | 0 | 0 | 1 | 0 | | 0 | 0 | 0 | 0 |
| 750 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 |
| 1000 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 |

### SEPTEMBER

| m. | St. 1415 | 1416 | ↓ A C | 1417 | 1418 | 1419 | 1420 | 1421 |
|---|---|---|---|---|---|---|---|---|
| 50 | 5 | 0 | | 0 | 0 | 0 | 0 | 0 |
| 100 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |
| 250 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |
| 500 | 0 | 4 | | 0 | 0 | 0 | 0 | 0 |
| 750 | 0 | 1 | | 0 | 0 | 0 | 0 | 0 |
| 1000 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 |
| 1500 | 0 | ? | | ? | ? | 0 | ? | 0 |

### OCTOBER

| m. | St. 1450 | 1449 | 1448 | 1447 | ↓ A C | 1446 | 1445 | 1444 | 1443 | 1442 | 1441 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 50 | 0 | 0 | 10 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 |
| 100 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 |
| 250 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 |
| 500 | 0 | 0 | 0 | 2 | | 0 | 0 | 0 | 0 | 0 | 0 |
| 750 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 |
| 1000 | 0 | 0 | 0 | 0 | | 0 | ? | 0 | 0 | 0 | 0 |

### NOVEMBER

| m. | St. 1472 | 1473 | 1474 | 1475 | ↓ A C | 1476 |
|---|---|---|---|---|---|---|
| 50 | 0 | 0 | 0 | 0 | | 0 |
| 100 | 0 | 5 | 0 | 0 | | 0 |
| 250 | 0 | 2 | 0 | 0 | | 0 |
| 500 | 0 | 0 | 0 | 0 | | 0 |
| 750 | 0 | 0 | 0 | 0 | | 0 |
| 1000 | 0 | 0 | 0 | 0 | | 0 |

*Euphausia triacantha*, *E. vallentini* and *E. frigida* (Tables XVIII, XIX and XX) occurred only in very small numbers for they are too large and active to be caught to any large extent in the 70-cm. nets. However the figures show that *E. triacantha* was taken near the surface as well as at other depths in March and September, and at moderate depths in other months. *E. vallentini* was taken near the surface only in March and *E. frigida* in each month except December, when no specimens were taken. The data from 80° W suggest that these three species are not confined to the warm deep water in winter, but there is not sufficient material to make this certain. However, as the species of *Euphausia* are important constituents of the plankton I have examined some records from other sources. Mr D. D. John has kindly shown me his analyses of the catches of *Euphausia* taken during the second commission of the 'Discovery II' (1931–33) and it is evident from these that all three species are to be found near the surface at any time of year. *E. triacantha* has been taken in the upper layers in various localities in February, April, May, June, September, November and December; *E. vallentini* in February, April, May, June, September, October and November; and *E. frigida* in January, February, April, May, June, September, November and December. This of course does not prove that they live at exactly the same average depth at all times of year, but it does seem certain that there is no wholesale retirement into deeper water such as we see for instance in *Calanus acutus*.

The remainder of the species which were identified and counted (*Clione*, *Auricularia*, etc.) were so scarce that they must be disregarded here.

## EXAMPLES FROM OTHER PARTS OF THE ANTARCTIC

The annual vertical migration exhibited by *Rhincalanus gigas*, *Eukrohnia hamata*, and *Calanus acutus* is of considerable importance. In the preceding pages it has been shown only that this migration took place in 80° W in 1934. It would be extremely surprising if a species undertook a mass movement on this scale in one locality in a particular year and did not act in the same way throughout the Antarctic every year. That is to say such an extensive migration is not likely to have been merely the result of any unusual hydrological conditions in that year or any peculiarity associated with that locality. However, if a few other samples, taken in other years and in other parts of the Antarctic, show the same difference between the summer and winter distribution, there can hardly be any further doubt that the annual migration is everywhere a normal characteristic of these species.

Apart from the work in September 1934 there have not been many occasions on which the Discovery Committee's ships have collected plankton samples in winter, but in September 1928 the 'William Scoresby' worked a number of stations around South Georgia and between South Georgia and the Falkland Is., and in the winter of 1932 the 'Discovery II' gathered much material in the course of a long circumpolar voyage.

It appeared to me sufficient for the present purpose to contrast the samples from a pair of winter and a pair of summer stations taken by the 'William Scoresby' near South Georgia, and to make similar comparisons between some summer and winter samples taken by the 'Discovery II' in the western part of the Pacific sector of the Antarctic. In both these localities the conditions are quite different from those in 80° W. The positions of these stations are plotted in Figs. 8 and 9, and details of them are as follows:

*Winter stations*

| | | |
|---|---|---|
| WS 254. | 53° 03′ S, 46° 58′ W. | 22. viii. 28. |
| WS 255. | 53° 23′ S, 44° 10′ W. | 22–23. viii. 28. |

*Summer stations*

| | | |
|---|---|---|
| WS 315. | 53° 26′ S, 43° 49′ W. | 2. xii. 28. |
| WS 316. | 52° 56′ S, 46° 26′ W. | 3. xii. 28. |

*Winter stations*

| | | |
|---|---|---|
| 950. | 59° 05′ S, 163° 46′ W. | 7–8. ix. 32. |
| 951. | 61° 26′ S, 160° 03′ W. | 8. ix. 32. |

*Summer stations*

| | | |
|---|---|---|
| 1271. | 65° 05′ S, 166° 08′ W. | 19. i. 34. |
| 1273. | 62° 08′ S, 168° 59′ W. | 20. i. 34. |

Sts. WS 254 and WS 255 were included in a line of stations worked between South Georgia and the Falkland Is. (that is in the north part of the Scotia Sea) in August, 1928, and Sts. WS 315 and WS 316 were worked very near to them in the following December. The two pairs of stations therefore are quite suitable for a comparison of winter and summer distribution. Both of course are in Antarctic water. Sts. 950 and 951 were included in a line running south eastwards from New Zealand in September, 1932, and Sts. 1271 and 1273, worked in January 1934 are the nearest summer stations in that part of the Antarctic. (At St. 1272 the vertical 70-cm. nets were not used).

The vertical distribution of *Rhincalanus gigas*, *Eukrohnia hamata* and *Calanus acutus* at these stations is shown in Table XXI. In this table the left-hand station of each pair is the more southerly one.

It will be seen that in the north part of the Scotia Sea in winter (Sts. WS 255 and 254) *Rhincalanus gigas*, as in 80° W in winter, lay almost entirely in deep water below 250 m., and the largest numbers occurred between 250 and 750 m. In summer (Sts. WS 315 and WS 316) there were very few in deep water. The vast majority were above the 250-m. level and by far the largest catch was taken between 50 and 100 m. The winter distribution in the western Pacific (Sts. 950 and 951) were similar, large numbers being taken below 250 m. and hardly any in shallow water. In summer here the species was scarce at all depths at St. 1271, but at St. 1273 large numbers were taken only at the surface. Thus everything points to an annual vertical migration of this species in the Scotia Sea and the western Pacific similar to the annual migration which has been demonstrated in 80° W.

Similarly *Eukrohnia hamata* lies in deep water at Sts. WS 255 and 254 and in shallow water at the corresponding summer stations. It is again in deep water at Sts. 951 and 950. At one of the summer stations (1271) its return towards the surface is less apparent, but at St. 1273 it was abundant at the surface and comparatively scarce in deep water.

In *Calanus acutus* we have the same results again, but the difference between the summer and winter level is even more marked than in the other two species. In winter it appears to have been entirely confined to depths exceeding 500 m., and the main concentration may well have been even deeper than 1000 m. and so have been missed by the nets. In summer the vast majority again are at depths of less than 250 m. Enormous numbers occurred at St. 1273 between 0 and 100 m., but at St. 1271 no actual concentration appears at the surface.

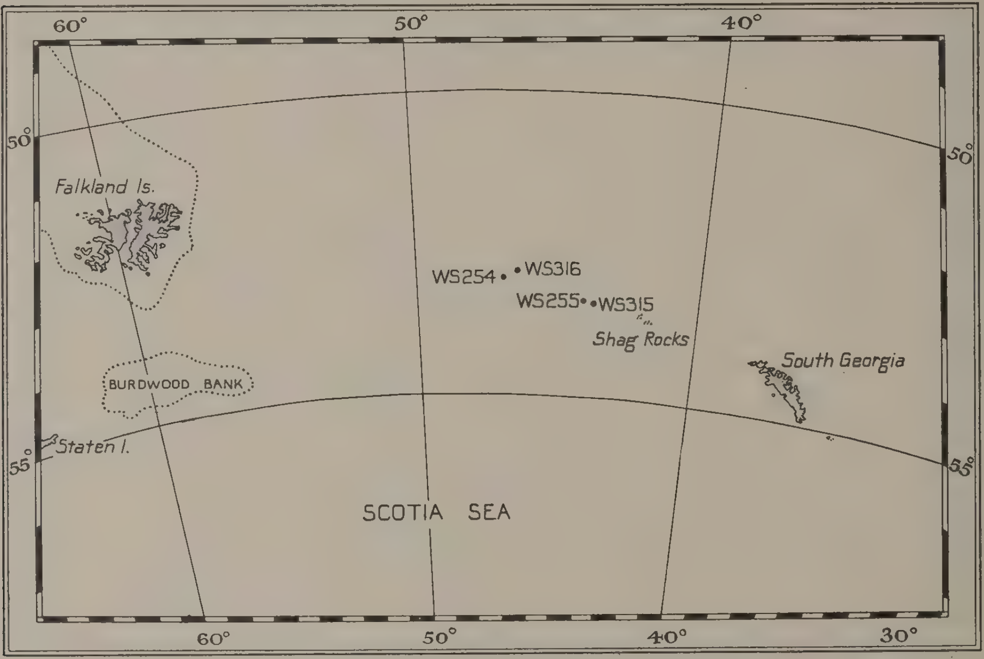


Fig. 8. Winter and summer stations in the Scotia Sea.

Thus we find all three species in deep water in winter and in shallow water in summer. The summer distribution is not so clearly brought out at St. 1271 as at St. 1273, but these two stations may be appropriately compared with Sts. 1222 and 1223 in 80° W (see Figs. 5–7, vertical sections for December). The same three species showed the normal summer concentration near the surface at St. 1223 but were deeper and scarcer at St. 1222. It seems that in the higher latitudes the winter distribution persists into the early part of the summer, and it may be pointed out that St. 1271 is well to the south of St. 1273.

It has been shown now that in three different parts of the Antarctic—in the south-east Pacific (80° W), in the north part of the Scotia Sea, and in the south-west Pacific—*Rhincalanus gigas*, *Eukrohnia hamata* and *Calanus acutus* (or at least the adult and sub-adult members of these species) were found mainly to inhabit the upper layers of the water in summer and the deeper water in winter. Ommanney (1936, p. 296) also finds evidence that in the Bellingshausen Sea current and the Antarctic water of the West Wind Drift *Rhincalanus gigas* normally inhabits the surface layer in summer and the deeper water in winter. There cannot then be very much doubt that the annual vertical migration implied in this difference in vertical distribution normally takes place throughout at least the greater part of the Antarctic.

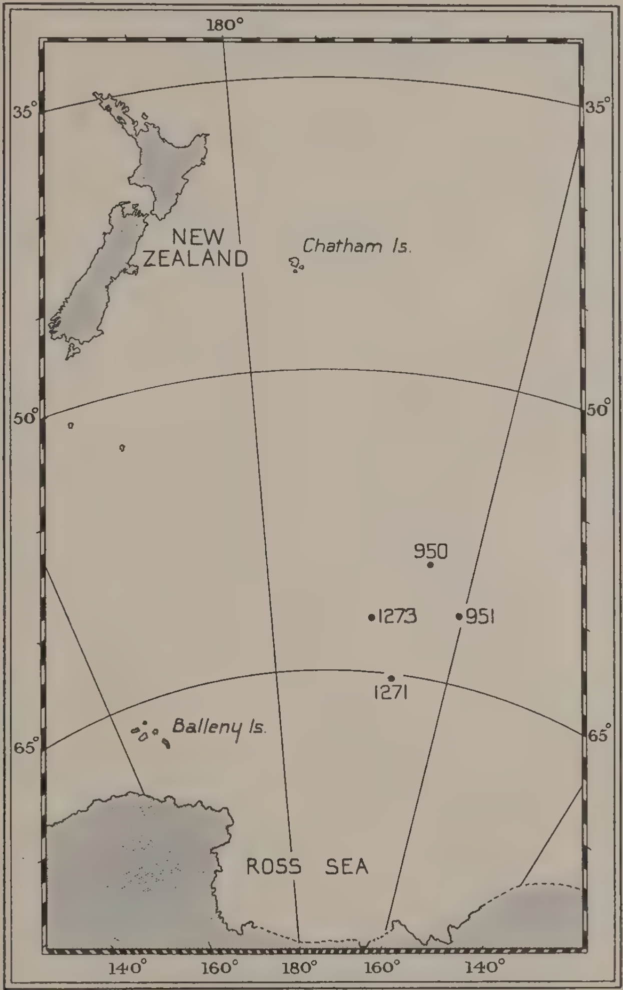


Fig. 9. Winter and summer stations in the western Pacific Ocean.

## THE PROCESS OF CIRCULATION

It has been shown in previous papers (Mackintosh, 1934; and Hardy and Gunther, 1935) that some species of the Antarctic macroplankton undergo extensive daily vertical migrations while others do not. Most of the species considered on pp. 381 to 404 are not much influenced by the alternation of daylight and darkness. This can be seen in most cases by inspection of Tables III–XX. Four of them however do make daily migrations, and move through a considerable range of depth. These are *Pleuromamma robusta*,

Table XXI. *Comparison of vertical distribution in winter and summer. Showing the distribution of three dominant macroplankton species in the Scotia Sea and the Western Pacific sector of the Antarctic.*

*Rhincalanus gigas*

| | Scotia Sea Winter | | Scotia Sea Summer | | Western Pacific Winter | | Western Pacific Summer | |
|---|---|---|---|---|---|---|---|---|
| | St. WS 255 | St. WS 254 | St. WS 315 | St. WS 316 | St. 951 | St. 950 | St. 1271 | St. 1273 |
| 0 m.–50 | 0 | 10 | 0 | ? | 0 | 0 | 0 | 355 |
| 50–100 | 0 | 20 | 0 | 455 | 5 | 0 | 5 | 350 |
| 100–250 | 0 | 3 | 78 | 80 | 0 | 3 | 5 | 18 |
| 250–500 | 246 | 220 | 10 | 3 | 656 | 304 | 28 | 56 |
| 500–750 | 179 | 272 | 0 | 3 | 61 | 135 | 1 | 9 |
| 750–1000 | 46 | 60 | 0 | 0 | 9 | 24 | 0 | 1 |

*Eukrohnia hamata*

| | Scotia Sea Winter | | Scotia Sea Summer | | Western Pacific Winter | | Western Pacific Summer | |
|---|---|---|---|---|---|---|---|---|
| | St. WS 255 | St. WS 254 | St. WS 315 | St. WS 316 | St. 951 | St. 950 | St. 1271 | St. 1273 |
| 0 m.–50 | 0 | 5 | 0 | ? | 0 | 0 | 0 | 194 |
| 50–100 | 0 | 5 | 0 | 245 | 5 | 0 | 80 | 565 |
| 100–250 | 17 | 20 | 35 | 17 | 0 | 2 | 22 | 103 |
| 250–500 | 115 | 115 | 3 | 4 | 120 | 71 | 101 | 22 |
| 500–750 | 41 | 49 | 2 | 5 | 23 | 37 | 17 | 12 |
| 750–1000 | 13 | 20 | 8 | 4 | 24 | 11 | 3 | 18 |

*Calanus acutus*

| | Scotia Sea Winter | | Scotia Sea Summer | | Western Pacific Winter | | Western Pacific Summer | |
|---|---|---|---|---|---|---|---|---|
| | St. WS 255 | St. WS 254 | St. WS 315 | St. WS 316 | St. 951 | St. 950 | St. 1271 | St. 1273 |
| 0 m.–50 | 0 | 0 | 0 | ? | 0 | 0 | 0 | 4865 |
| 50–100 | 0 | 0 | 5 | 160 | 0 | 0 | 70 | 2955 |
| 100–250 | 0 | 0 | 28 | 52 | 0 | 0 | 18 | 253 |
| 250–500 | 0 | 0 | 10 | 13 | 0 | 0 | 39 | 6 |
| 500–750 | 23 | 12 | 10 | 33 | 88 | 4 | 82 | 13 |
| 750–1000 | 37 | 54 | 6 | 4 | 448 | 19 | 98 | 6 |

*Euphausia triacantha*, *E. vallentini* and *E. frigida*. The rise and fall of *Pleuromamma* is clearly shown in Table VII. The three species of *Euphausia* were too scarce for the effect to be seen well in 80° W, but reference can be made to the previous papers mentioned above.

It is evident that if a species rises and sinks sufficiently far every day it may spend an equal amount of time in the northward moving surface water and the southward moving deep water, and would thus have the means of preserving the limits of its distribution without needing to sink to a lower average level at any one time of year. The fact that these four species do not appear to make any marked annual migration lends support to the theory that such species as *Calanus acutus* make their annual migration for the special purpose of compensating for their northward drift in the surface layers. It is true that *Pleuromamma* did not seem to reach the surface layers in December as it did in other months, but this phenomenon is hardly comparable to the annual migration of some other species.

The distribution of some of the less abundant species is not so easily explained, for some live in the warm deep water and rarely, if ever, enter the surface layers and others seem to keep to the surface at all times. All the species which have been picked out and counted from the N 70 samples in 80° W may be grouped as follows:

(1) No effective daily vertical migration but a marked descent from the surface layers in summer to the warm deep water in winter: *Rhincalanus gigas*, *Eukrohnia hamata*, *Calanus acutus*.

(2) Energetic daily migration but no extensive annual migration: *Pleuromamma robusta*, *Euphausia triacantha*, *E. vallentini*, *E. frigida*.

(3) Normally inhabiting the surface layers, but with no effective daily migration and no apparent annual migration: *Sagitta gazellae*, *Calanus propinquus* (adults), *Parathemisto gaudichaudi*.

(4) Normally inhabiting the warm deep water, with no effective daily migration but descending into slightly deeper water in winter: *Sagitta maxima*, *S. planctonis*, *Eukrohnia hamata* f. *antarctica* and possibly *Dimophyes arctica* (which in summer is usually taken in hauls from 250–100 m., and may actually live at the top of the warm deep water or the bottom of the Antarctic surface water).

(5) Scarce or irregularly occurring species whose distribution cannot at present be definitely classified: *Conchoecia hettacra*, *Primno macropa*, *Haloptilus oxycephalus*, *Clione antarctica*, *Haloptilus ocellatus*, *Auricularia antarctica*, *Diphyes antarctica*, *Sibogita borchgrevinki*, *Vanadis antarctica*.

Group 1 above includes the species of by far the greatest numerical importance in 80° W. It must be supposed that they drift northwards in the surface waters in summer and return southwards in the warm deep water in winter.

Species in Group 2 appear to adjust their distribution by daily instead of annual migrations between the surface layers and the deeper water.

Species in Group 3 must have some other method of maintaining their normal range of distribution. Reference must be made here to the recently published work of Fraser (1936) on the young stages of *Euphausia superba*. This important species which forms the food of whales in the Antarctic was unfortunately almost entirely absent from the catches in 80° W. Fraser shows that whereas the adults and adolescents are mainly confined to the Antarctic surface water there is evidence that the gravid females descend into deep water to lay eggs. The eggs, Nauplii and Metanauplii are normally found in the warm deep water while the Calyptopis and early Furcilia stages undertake daily migrations between the warm deep water and the Antarctic surface water. It is possible therefore that the species listed above under Group 3 have some similar device by which the return towards the south is effected only at an early stage in the life-cycle.

There is no evidence as to how the circulation of species in Group 4 takes place. Eggs or larvae might rise to the surface layer or conceivably even sink into the Antarctic bottom water. There is no obvious explanation of the descent of these species into slightly deeper water in winter.

It must always be remembered that the main drift of the water in both the surface and the warm deep layers is towards the east, and that the organisms (of Group 1) taken in say the surface in 80° W in December are not the same organisms nor the offspring of the organisms which were there in deep water in the preceding September. They must be supposed to have come from deep water somewhere far to the west, and presumably, as generation succeeds generation, they will work their way eastwards round and round the Southern Ocean. It must also be remembered that neither the surface water nor the warm deep water move steadily in a north-easterly and south-easterly direction respectively. There are changes of direction, eddies, and counter currents, and it is quite possible that a species living exclusively in the Antarctic surface water could find eddies on a scale large enough to bring back to high latitudes a certain proportion of the adult population. By active propagation such a proportion might be able to restore the full numerical strength of the species. The possible methods by which the plankton could be replenished in an ever-moving mass of water, and the influence on horizontal distribution of the reaction between vertical migrations and currents, might be discussed at great length. The object of this paper however is simply to show that there is positive evidence that one of the suggested methods is actually used by some species, namely an annual vertical migration between superimposed layers of water moving in different directions.

It might be objected that an organism starting in the Antarctic surface water in a high latitude might reach the Antarctic convergence in considerably less than half a year, or that if the warm deep water moves more slowly to the south than the surface water moves to the north the plankton organisms would need to spend most of their time in deep water. But even in summer such forms as *Rhincalanus* are not entirely confined to the surface layer, and there seems no reason why they should not adjust the speed and range of their drift by resorting to the faster or more slowly moving parts of either layer or by occasionally making short extra journeys from one to the other and so achieving an equilibrium in their circulation.

## SUMMARY

The preceding pages contain an account of an annual vertical migration which is undertaken by certain important plankton species in the Southern Ocean. It is shown that the three species which in places make up the bulk of the Antarctic macroplankton are mainly concentrated in the surface water in summer, but descend into very deep water in winter. Since there is a northerly component in the direction of movement of the Antarctic surface water and a compensating southerly component in that of the 'warm deep water' it is to be supposed that this vertical migration results in a large-scale circulation by means of which these species keep within the limits of their normal distribution.

The circulation is on a remarkably large scale, the vertical range being from four to six hundred metres and the horizontal range being presumably some hundreds of miles.

The data are derived principally from lines of stations repeated at different times of year by the 'R.R.S. Discovery II' in the meridian of 80° W, between about 55° S and the edge of the pack-ice. A similar vertical migration is shown to have taken place in other years and in other parts of the Antarctic, and there is little doubt that the phenomenon is normal and general in the higher latitudes of the Southern Ocean.

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# *RHIZOSOLENIA CURVATA* ZACHARIAS, AN INDICATOR SPECIES IN THE SOUTHERN OCEAN

By

T. JOHN HART, D.Sc.

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# *RHIZOSOLENIA CURVATA* ZACHARIAS, AN INDICATOR SPECIES IN THE SOUTHERN OCEAN

By T. John Hart, D.Sc.

(Plate XIV; Text-figs. 1–7)

## INTRODUCTION

It has long been known that planktonic diatoms are the dominant constituents of the phytoplankton of the Southern Ocean. Nearly all the species concerned have a very wide geographical range, and are able to tolerate considerable variation in the conditions of their environment. The discovery of a species with a range so restricted that it appears to lend itself to use as an indicator, was therefore considered of sufficient importance to justify the special study of its distribution and biology described here.

During our earlier work both Hardy (1935, p. 53) and I (1934, pp. 82, 161) found that while *Rhizosolenia curvata* appeared to find its optimum in the southern part of the sub-Antarctic Zone, it was occasionally found to the south of the Antarctic convergence, notably in the South Georgia area. In the course of the third commission of the R.R.S. 'Discovery II' our work in the Southern Ocean ranged from 50° E westwards to 180° W. Throughout the whole of the period November 1933–April 1935, I was able to make a preliminary examination of the phytoplankton catches within a very short time of their being brought on board, and I was very much struck by the consistency with which this species occurred in the neighbourhood of the Antarctic convergence. It appeared to me to lend itself very well to use as an indicator species, in the sense that F. S. Russell (1935) has used the term with reference to certain plankton animals.

The phytoplankton of the convergence region in which this diatom occurs is in general fairly characteristic, but the other constituents of the community are either cosmopolitan (e.g. *R. alata*) or have such a marked seasonal periodicity that they could never be of much value as indicators. None of them, not even *R. polydactyla* (cf. Hart, 1934, p. 79), has such a limited geographical range as *R. curvata*, and although the latter is rarely very numerous, it is present at all seasons, and so easily recognized by reason of its large size and highly characteristic appearance, that it seems by far the best biological indicator of the southern limit of sub-Antarctic surface water. That this surface water is frequently forced some small distance south of its normal limit, the Antarctic convergence, has always been realized. The agencies by which this is brought about are either temporary wind currents, or other more complicated elemental disturbances. It seems very significant that wherever it has been possible to show such southward movement hydrologically, there also *R. curvata* was to be found in the plankton.

After my return from the third commission, therefore, I took the first opportunity of working through all the material that could possibly be expected to include this species. The material collected on the second commission, when the R.R.S. 'Discovery II' completed a circumpolar cruise, was similarly dealt with. The results, which are described at length in this paper, appear to confirm the initial hypothesis that this species is a valid indicator of the southward limit of the sub-Antarctic influence in the surface water of the Southern Ocean.

*R. curvata* Zacharias was first described by two independent workers in 1905, and confusion in the synonymy has resulted. Zacharias's description of the species, from a single sample obtained some 300 miles south-west of Cape Horn, was published in July of that year (Zacharias, 1905). His description is followed by the statement that it appears to him to be new to science, but that he puts forward this idea with "the reservation that it may well have been discovered in the material collected by the 'Valdivia', which is even now being worked up" (pp. 120–1). This reservation was well justified, for Karsten's manuscript with the description of the species under the name *R. curva* (Karsten, 1905, p. 97, Taf. xii, fig. 2) had already been received by the editors in April. I was unable to discover the exact date of Karsten's paper, and in my report of 1934 (p. 161) I used the name that Karsten had given.

When it became evident that the species was of peculiar ecological interest, I was led to study the subsequent literature, and found that Zacharias (1906, p. 557) claimed priority for *curvata*. Further, the justice of this claim is acknowledged by Karsten in his Atlantic Ocean report (1906, p. 164) under the subheading of *R. semispina*, another member of the genus. It thus appears that the name *R. curvata* Zacharias must be retained, and *R. curva* Karsten is to be regarded as a synonym. I have had the advantage of being able to discuss the point with Mr N. I. Hendey, who has recently been engaged in a systematic study of our diatom collections, and he has confirmed this view.

Before passing to a discussion of the early records of the species, I should state that throughout this paper I have followed the hydrological definitions of the surface water laid down by Deacon (1933, 1937).

Previous records of the occurrence of *R. curvata* have been made by Zacharias (1905, 1906), by Schimper in Karsten's reports on the material collected by the 'Valdivia' (Karsten, 1905, 1907), by Mangin (1922) in his report on the phytoplankton collected by the 'Scotia', and by Hardy (1935) and myself (1934) from material collected in the course of the Discovery Committee's investigations.

Zacharias's first record (1905, p. 120), from 300 sea miles south-west of Cape Horn, is from the typical habitat of the species, which, as I hope to show in this paper, is the more southerly portion of the sub-Antarctic surface water. In 1934 (p. 161) I expressed surprise at his finding it in such numbers so far south, but more recent work has shown that the Antarctic convergence usually lies farther south in that longitude than the data then available indicated. Zacharias's second record (1906, p. 556), however, is most extraordinary. It is from 12° N, 28° W, in the tropics between St Paul's Rocks and the Cape Verde Islands. In all the 160 records of the species I have been able to get together, there is only one other doubtful record of its appearance north of the sub-Antarctic Zone, and I have been able to work through a considerable amount of tropical and subtropical material obtained during our voyages to and from the Antarctic, in addition to a large proportion of our enormous collection of samples from the more southerly areas. It is unthinkable that Zacharias, whose description of the species is mainly accurate, should have confused it with the warm-water species *R. robusta* Norman, though the superficial resemblance between the two is sometimes strong, as is shown by one of Karsten's figures of the latter (1906, Taf. xxix, fig. 10). The dimensions Zacharias quotes for his single supposedly tropical specimen of *R. curvata* are also against such a view. The most probable explanation is that an error was made in collection, and that the specimen did not originate at the locality from which it was recorded.[1]

It is possible that the previous record of a single specimen obtained by the 'Valdivia' at the island of St Paul, which is just north of the subtropical convergence in the Indian Ocean, may have been due to an error of this kind. This is unlikely, for it is evident that the 'Valdivia's' collections were most carefully made; but I do not believe that these two northerly records, one of them almost certainly made in error, invalidate the observation that *R. curvata* is essentially a sub-Antarctic species.

Apart from the St Paul Island specimen, Schimper's records, quoted by Karsten (1905, 1907), show that *R. curvata* occurred at four other stations worked by the 'Valdivia'. Two of these were just to the south of the Antarctic convergence north-east of Bouvet Island, one just south of the convergence off Kerguelen, and the last in the sub-Antarctic Zone in the Indian Ocean some 300 miles north-east of that island. Thus three of the four records lie south of the average position of the Antarctic convergence as we know it to-day. However, apart from minor changes in the position of the convergence, which are known to occur, it seems highly significant that all three records are from localities in which sharp changes in the relief of the sea-floor may be expected to complicate the movements of the water layers. The two Atlantic stations were very near the Meteor bank, while that to the south of Kerguelen lies almost on the Kerguelen-Heard Island ridge.

Mangin (1922) records the species from two of the stations worked by the 'Scotia' in the middle of the South Atlantic, one to the north of the convergence, where it was "fairly common"; one to the south, where it was "rare". The positions of all these early records, except that of Zacharias's first sample, which is not accurately known, are shown by distinctive symbols on the general distribution chart in the concluding section of this paper (Fig. 7).

[1] The samples upon which Zacharias's two papers are based were obtained for him by Herr Wahlmann, a seaman on a sailing ship, who collected them as opportunity offered—in port, or when the ship lay becalmed. We are justified in assuming that his collecting was carried out under difficulties. From the sequence of dates and localities of the samples, it seems fairly certain that Herr Wahlmann's ship was a nitrate clipper on the regular run between Chilean ports and Europe, round Cape Horn. It is probable that this tropical sample was the first one that he had been able to get after his unusual opportunity of collecting south of Cape Horn, and his net, which may have been stowed away wet, may have retained some specimens of the southern species. The fortuitous occurrence of diatoms from previous hauls is a potent source of error in studying their distribution, unless the nets are carefully washed down and dried after use. Zacharias does not give the date at which the first sample containing *R. curvata* was obtained, but it was certainly prior to the tropical haul in question, and none of the other catches he describes intervened, for he gives the dates of all of them.

## MATERIAL AND METHODS

The bulk of the material upon which this paper is based consisted of phytoplankton samples obtained in our routine hauls with the Gran international net of 50 cm. diameter, which is fished vertically from 100 to 0 m. A large majority of these were obtained during the second and third commissions of the R.R.S. 'Discovery II', 1931–5. Information from the earlier sources mentioned in the introduction has also been taken into account, and I have tabulated some earlier data obtained by similar methods, along with those which are presented here for the first time.[1]

During the third commission of the R.R.S. 'Discovery II' I made a preliminary examination of the phytoplankton at almost every station. For this purpose I used a few drops from the catch obtained by a vertical haul with a net of similar type to that recently employed by Harvey (1934) for estimating the quantity of phytoplankton colorimetrically. *R. curvata* was always noted when present, and in this way, with the aid of the published observations already referred to, a good preliminary idea of the distribution of the species was obtained. This was used in planning the subsequent work. Nearly all our observations falling within its normal range were obtained on cruises to and from the Antarctic Zone, with the stations spaced at regular intervals. In working up the material in detail I examined the Gran net samples from all the stations within the sub-Antarctic Zone, and continued working north and south of the normal range of the species until I had gone three stations beyond its last appearance on each series of observations, except where the series itself did not extend far enough. I believe that this has proved adequate to determine the extreme range of the species. Moreover, almost all the phytoplankton collected during the two commissions, amounting to some 750 samples, has been subjected to preliminary examination by Mr D. Dilwyn John or myself, so that there is little chance that any unusual extension of the normal range of so conspicuous a species would have escaped notice.

The negative evidence obtained in the manner outlined above has not been tabulated; but the more significant negative records marking the limits of *R. curvata* on most of the individual lines of stations, have been plotted on the distribution charts. In the Scotia Sea, where many of our hauls containing this species were obtained on lines of stations worked between South Georgia and the Falkland Islands, I have not attempted to plot negative records to the south of the extreme range observed. The large number of phytoplankton analyses from this area already published (Hart, 1934) renders such a procedure unnecessary.

The preserved samples were worked up by ordinary Hensen counting methods, with the added advantage that as only one conspicuous species was being dealt with, it was possible to work with very much larger fractions of the total catch than could have been used if a complete analysis of the phytoplankton present had been aimed at. The only samples with which it was necessary to examine fractions smaller than 1/300 were those few where the phytoplankton was so heavy that even the large frustules of *R. curvata* might have been obscured by the mass of other species present. The accessories used to fractionize the samples were Stempel flasks, measuring cylinders, and Stempel pipettes, all of the usual type.

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[1] The data so treated have been taken from the tables of phytoplankton analyses published by Hardy (1935) and Hart (1934), and were obtained at the following stations worked by the research vessels: Sts. 137, WS 34, WS 46, WS 68–WS 70, and WS 110–WS 113 from Hardy; and WS 518–WS 523, 633, 634 and 648–658 from Hart. The prefix WS denotes stations worked by the R.R.S. 'William Scoresby'; stations without this prefix were worked by R.R.S. 'Discovery' and R.R.S. 'Discovery II'.

The microscope used was a monocular instrument of the usual type, fitted with a large mechanical stage. The ordinary $\frac{2}{3}$ and $\frac{1}{6}$ in. objectives were ample for the work in hand. The fraction to be examined was spread over a definite rectangular area on a large slide ruled in 2 mm. squares. Counting was effected by working up and down the rows of squares, using a rather low-powered ocular, so that both sides of a square just entered the field under low power, until the whole fraction had been examined. As each frustule of *R. curvata* appeared, its diameter was measured under the higher power with the aid of a micrometer eyepiece. No attempt to carry out a complete analysis of all the phytoplankton present was made, but the more abundant forms or more obvious dominants in each sample were noted.

Single specimens or empty frustules of *R. curvata* were not considered adequate proof of its presence at any given station. If only one individual was seen in a fraction, other fractions of the same sample were worked through until at least five had been seen. In this way it is hoped that the risk of basing records on fortuitous specimens from previous net hauls has been minimized, although it is impossible to eliminate it altogether.

All the known positive records of the species, except some of our repeated series of observations in longitude 80° W, which lie too close together to be plotted clearly, are given on the distribution charts (Figs. 1–4 and 7). The results obtained in longitude 80° W have been plotted separately in Fig. 5. The tables deal only with the records for which quantitative data have been obtained by the methods described above. In addition to the estimated numbers of *R. curvata* per net haul, they show the station number, date, and approximate distance in sea miles of each record from the average position of the Antarctic convergence, and the surface temperature. In describing the relation of the stations to the Antarctic convergence, it will be seen that the phrase "on the Antarctic, or sub-Antarctic side of the convergence" has been used, instead of the more obvious "north or south". This has been done because the course of the convergence is locally complicated; its main component is not always east and west. For example, in the Scotia Sea, in a very important region from the point of view of this study, it takes an S-shaped course, resulting in a short projection of sub-Antarctic surface water eastwards with Antarctic surface water both to the north and south of it. Surface temperatures alone have been used because many of the observations are from intermediate stations at which full hydrological data were not obtained.

In order to obtain some idea of the seasonal variation in abundance of *R. curvata*, the estimations have been grouped into month classes and averaged (Fig. 6). The data are insufficient to justify any of the more desirable statistical elaborations. One fact, however, seems to show that these arithmetical means have some real significance: the very marked maximum in February was partly due to exceptionally rich hauls obtained in 1931, but if this series is excluded it still remains obvious that the maximum is reached in February although its numerical value is greatly reduced. It should be noted that all tables and diagrams relating to seasonal effects have been arranged as if the year began on July 1. This seems the easiest way in which to indicate the reversal of the seasons in the southern hemisphere.

The average positions of the Antarctic and subtropical convergences shown on the distribution charts are taken from Deacon (1937). I have also benefited greatly from the opportunity of discussing some of the hydrological points involved in this work with him and with Mr A. J. Clowes, from whose notes the probable positions of the Antarctic convergence on our several series of observations in longitude 80° W have been taken.

I was led to study the size relations of *R. curvata* by Mr R. S. Wimpenny, who very kindly allowed me to read the proofs of his most interesting paper on *R. styliformis* in the North Sea (Wimpenny, 1936). *R. curvata* is circular in section, and apart from its regular curvature it closely resembles a robust individual of *R. styliformis* in general form. It was therefore considered that of all possible measurements the diameter was most likely to bear a reasonably constant relation to the volume, since the organism is essentially cylindrical.

In attempting to trace the seasonal variation in size, and the presence or absence of a correlation between size and temperature, I have followed Wimpenny's methods so far as the limitations of my material permitted. Whereas Wimpenny (1936) was dealing with abundant material from localized populations, I was confronted with scanty material distributed all round the world. The methods adopted in the endeavour to make the correlations fairly comparable were as follows:

In studying seasonal variation in size, data from the Scotia Sea only have been used, except for the autumn and winter months of May, June and August. At these times I was forced to include material collected in the South Atlantic and Indian Oceans in order to get a sufficient number of observations. Between five and ten stations spread over each month were selected, within the organism's normal temperature range, and additional measurements over and above those made in the ordinary routine examination of the samples were taken, so that the number from each station was nearly equal and the total number over 200. The months in which it was impossible to obtain strictly comparable data are indicated by an asterisk in Table VIII. The measurements for each month were divided into 10$\mu$ diameter classes: $< 29\mu$, $30$–$39\mu$, $40$–$49\mu$ and so on. The percentage frequency of each class was calculated and the results for each month entered in the table.

The measurement data obtained in the initial routine examination of the samples in which *R. curvata* occurred were used to compute the mean diameter of the species. These data amounted to 3024 measurements distributed irregularly over 113 stations.

The figure arrived at was 62·7$\mu$. In order to indicate the extent to which the individuals tended to be larger or smaller than the mean in any given month, the percentages in the several diameter classes above and below 60$\mu$ were therefore added together and entered in two additional columns, the percentages below 60$\mu$ to the left, and those above 60$\mu$ to the right of Table VIII.

In the attempt to correlate size and temperature suitable samples have been grouped together for each degree of temperature over the whole of the organism's temperature range. As far as possible these samples were selected from among those taken in the Scotia Sea and adjacent areas, during the months in which *R. curvata* appears to find its seasonal optimum. As with the endeavour to follow the seasonal variation in size, however, it was necessary to bring in some data not strictly comparable with those forming the main body of the evidence, in order to cover the lower extreme of the range, for which spring observations only were available. At all the other temperatures ample data were available from samples taken in late summer (Table IX). In all other respects the data indicating the degree of correlation between size and temperature have been treated in the same way as those indicating the seasonal variation in size.

One other aspect of size variation was studied with a view to illustrating the application of these measurement investigations to the use of *R. curvata* as an indicator species. This was a correlation between size and distance from the Antarctic convergence. It is obvious that this relation should be a broad reflection of the temperature effect, slightly masked by the seasonal variation. For this purpose all the measurements obtained in the initial examination of the samples were used. The samples were grouped according to their distance from the convergence, and the percentage frequencies of the diameter classes in each grouping were worked out and tabulated as before (Table X). The average numbers of *R. curvata* per net haul in each of these distance groupings has also been shown in the same table.

I wish to express my thanks to Miss E. C. Humphries, who has prepared the text-figures for publication, and to the staff of the cryptogamic and general sections of the library of the British Museum (Natural History) whose ready assistance has been very helpful.

## OBSERVATIONS IN THE SCOTIA SEA AND SOUTH GEORGIA AREA

The fact that *R. curvata* is occasionally to be found in small numbers round South Georgia, which lies some 220 miles to the south of the Antarctic convergence, was first established by Hardy (1935, p. 53). It was obvious even at that time that it was never frequent there, but was relatively abundant in sub-Antarctic waters to the north and west. Subsequent examination of more than 120 samples from the South Georgia area, many of the results of which have already been published (Hart, 1934, Tables II–XVI), proved that *R. curvata* was very rare and usually found only to the west of the island, in numbers fewer than 1000 cells per net haul. Nevertheless, the undoubted presence of more or less living individuals in this area, well south of the Antarctic convergence, demands explanation if the claim that it is essentially a sub-Antarctic species is to be justified. The large proportion of empty frustules observed is in itself a strong indication that round South Georgia the species does not find itself in a suitable environment, as they are rarely seen where the species flourishes farther north. The suggestion put forward in 1934 (p. 188) to account for the maintenance of the abundant flora of the northern part of the Antarctic Zone still seems to furnish the only reasonable explanation of its presence. I quoted the appearance of dead and dying individuals of *R. curvata* and other sub-Antarctic species over the bank to the north-west of South Georgia in support of the hypothesis that resting stages of truly Antarctic diatoms might be transported southwards from the convergence region by the same agency, namely, the warm deep water. It was thought that the appearance of the sub-Antarctic species in the area indicated was due to subsurface transportation followed by vertical mixing where the circulation was complicated by the bottom topography between South Georgia and the Shag Rocks. After the examination of a much larger amount of material, this explanation of the presence of *R. curvata* in the region in question still seems to hold good, with the necessary modification that not all the individuals so transported are dead. Several of the South Georgia specimens appeared to be living, and able to survive a short period at the height of summer. Most of them, however, looked very unhealthy, and the absence of large individuals, such as would result from the formation of auxospores, strongly suggests that the species is unable to persist in this area for any length of time.

Table I shows Hardy's records of *R. curvata* in South Georgian waters from material collected during the summer of 1926–7. Although it is never a very abundant species, even in its proper habitat, comparison with Table II clearly demonstrates its relative scarcity in the South Georgian samples.

Table I. *Early observations round South Georgia*

| Station | Date | Surface temp. ° C. | No. of *R. curvata* per N 50 V haul |
|---|---|---|---|
| 137 | 22. xii. 26 | 1·22 | 1200 |
| WS 34 | 21. xii. 26 | 1·05 | 1000 |
| WS 46 | 8. i. 27 | 2·19 | 150 |
| WS 110 | 26. v. 27 | 0·93 | 100 |
| WS 112 | 27. v. 27 | 0·90 | 300 |
| WS 113 | 28. v. 27 | 0·90 | 400 |

These records may be taken as typical of the scanty occurrence of the species off South Georgia, for none of the samples from that area examined subsequently contain more than the maximum number, 1200 cells per net haul, recorded by Hardy from St. 137.

It is possible that the presence of this species at the 'Valdivia's' most southerly records was due at least in part to the same factor which is believed to account for its presence round South Georgia. These records are from the South Atlantic north-east of Bouvet Island, close to the Meteor bank, and south of Kerguelen on the eastern margin of the submarine ridge connecting Kerguelen and Heard Island. Thus both these records are from localities in which sharp changes in bottom relief may be expected to complicate the circulation of the water layers.

The results obtained in the Scotia Sea proper are given in Table II, and the positions of the stations are plotted in Fig. 1.

Broadly speaking, the largest numbers of *R. curvata* lay on the sub-Antarctic side of the convergence, e.g. Sts. WS 69, WS 519. Several catches of more than average quantity were, however, obtained on the Antarctic side of the convergence. At some of these the high-surface temperatures furnish good evidence of sub-Antarctic water having been transported beyond its normal limit. Truly Antarctic surface water is rarely warmed above 4·5° C., while the extreme limit is probably about 5° C. in February close to the convergence. Yet Sts. 634 and 830, where the surface temperatures were 4·57 and 5·13° C. respectively, and where a considerable quantity of *R. curvata* was present, lay well within the normal limits of the Antarctic Zone. Again, at St. 1335, where another moderately rich haul was obtained, the temperature, 3·17° C., was very high for a station so far within the limits of the Antarctic Zone, if the time of year is taken into consideration. This argument gains force from comparison with data given by Deacon (1933, p. 199, fig. 14) for a station lying approximately the same distance within the convergence, but farther eastwards, due north of South Georgia.

Examination of the distribution chart in conjunction with the data tabulated above, however, shows that so many records of *R. curvata* have been obtained on the Antarctic side of the average position of the Antarctic convergence in the Scotia Sea, at quite low temperatures, that they cannot all be explained simply on the grounds of actual movement of unmixed, or slightly mixed sub-Antarctic water beyond its normal limit, even when full allowance is made for seasonal variation in temperature. It is believed that the presence of the species in these localities is to be explained by its ability to persist for some time in mixed water, initially formed by direct transport but so cooled and diluted that its mixed origin is no longer demonstrable by ordinary physical criteria. We know that the species can remain alive for short periods round South Georgia, so that it should be quite possible for it to continue for a considerable time in mixed water in which the sub-Antarctic element has been almost completely dissipated, especially during the warmest months of the year. In spring the very small numbers of the species present at the stations where the lower temperatures were recorded strongly suggest that the environment was unfavourable, while the measurement investigations described in a later section of this paper (p. 438) supply good evidence that it can never persist within the Antarctic Zone indefinitely.

The distribution chart (Fig. 1) shows that nearly all the records of *R. curvata* on the Antarctic side of the convergence in the Scotia Sea lie east, or north-east of the easterly projection of sub-Antarctic water where the S-shaped bend in the convergence occurs. The preponderance east of the upper, or more northerly loop is slight but fairly well marked. Mixing across the convergence will obviously tend to be most frequent in this region, where the convergence lies more or less normal to the path of the prevailing westerly gales instead of parallel to it, as elsewhere. Once within mixed water on the Antarctic side of the convergence, the general north-easterly trend of the surface drift would tend to sweep the species to positions opposite the northern loop of the S, although their probable "point of entry" is the eastern extremity of the southern loop.

Only one of the Scotia Sea records of *R. curvata* lies beyond the extreme probable limit of sub-Antarctic influence, which Deacon puts at approximately 150 miles. This station, 658, was worked over the bank between the Shag Rocks and South Georgia, so that the presence of the species there is probably due to the same factor which is thought to account for its presence round the island of South Georgia itself, namely subsurface transport followed by vertical mixing. A few other more easterly Scotia Sea records lie close to the Shag Rocks, and it is possible that these are also due to the same factor. Comparison of Fig. 1 with the bathyorographical chart of the area published by Herdman (1934, pl. xlv) shows this possibility very clearly.

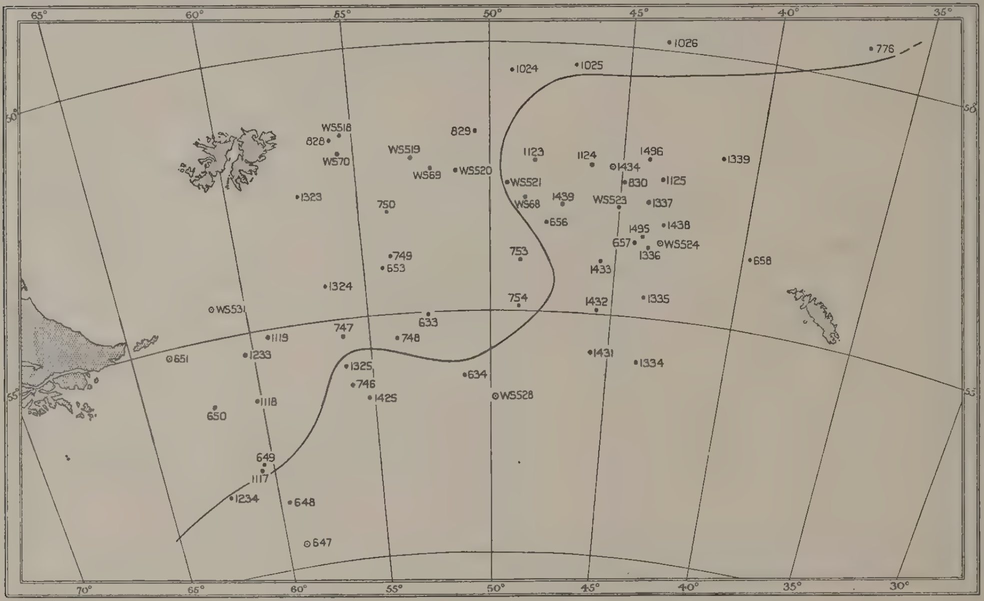
65°
60°
55°
50°
45°
40°
35°
50°
55°
70°
65°
60°
55°
50°
45°
40°
35°
30°
1026
776
1024
1025
WS518
828
WS70
829
WS519
WS69
WS520
1123
1124
1496
1434
1339
WS521
830
1125
1323
750
WS68
1439
WS523
1337
656
1495
1438
657
WS524
1336
658
749
653
753
1433
1324
754
1432
1335
WS531
633
747
748
1119
1233
651
1431
1334
1325
634
746
1425
WS528
1118
650
649
1117
1234
648
647

Fig. 1. Observations of *Rhizosolenia curvata* in the Scotia Sea.

One other feature of the records in the Scotia Sea which is worthy of special note is the distribution of the richer hauls of *R. curvata* in the later part of the year. It can be seen from Table II that out of the ten catches in which more than 10,000 individuals were recorded, seven were obtained in February, two in March and one, the smallest, in April. This is in broad agreement with the results of a study of the seasonal variation in abundance described later, but it may be mentioned here that it seems to present an interesting analogy to the seasonal behaviour of other members of the genus in corresponding latitudes in both hemispheres. These also tend to show their maximum

Table II. *Observations in the Scotia Sea*

| Station | Date | Approx. distance from average position of convergence in miles | On Antarctic (A) or sub-Antarctic (S) side of convergence | Surface temp. ° C. | No. of *R. curvata* per haul |
|---|---|---|---|---|---|
| WS 68 | 21. ii. 27 | 14 | A | 5·29 | 27,800 |
| WS 69 | 22. ii. 27 | 76 | S | 7·01 | 136,000 |
| WS 70 | 22/23. ii. 27 | 175 | S | 7·20 | 1,200 |
| WS 518 | 27. ii. 30 | 170 | S | 7·39 | 54,000 |
| WS 519 | 27. ii. 30 | 100 | S | 5·79 | 126,000 |
| WS 520 | 27/28. ii. 30 | 47 | S | 6·35 | 24,000 |
| WS 521 | 28. ii. 30 | 8 | A | 4·59 | 18,000 |
| WS 523 | 1. iii. 30 | 93 | A | 4·16 | 27,000 |
| 633 | 5. iii. 31 | 52 | S | 5·14 | 1,200 |
| 634 | 6. iii. 31 | 25 | A | 4·57 | 16,200 |
| 648 | 12. iii. 31 | 50 | A | 3·74 | 3,420 |
| 649 | 12/13. iii. 31 | 8 | S | 6·71 | 1,200 |
| 650 | 13. iii. 31 | 100 | S | 7·22 | 300 |
| 653 | 21. iii. 31 | 92 | S | 6·22 | 4,500 |
| 656 | 24. iii. 31 | 19 | A | 4·78 | 900 |
| 657 | 25. iii. 31 | 105 | A | 2·19 | 1,500 |
| 658 | 26. iii. 31 | 217 | A | 2·64 | 300 |
| 746 | 28/29. xi. 31 | 30 | A | 3·41 | 600 |
| 747 | 29. xi. 31 | 24 | S | 4·70 | 300 |
| 748 | 29. xi. 31 | 15 | S | 4·38 | 1,100 |
| 749 | 30. xi. 31 | 108 | S | 4·59 | 700 |
| 750 | 30. xi. 31 | 154 | S | 4·73 | 300 |
| 753 | 2/3. xii. 31 | 30 | S | 2·59 | 900 |
| 754 | 3. xii. 31 | 22 | S | 2·59 | 1,000 |
| 776 | 17. xii. 31 | 15 | S | 5·29 | 800 |
| 828 | 17. ii. 32 | 190 | S | 7·81 | 600 |
| 829 | 18. ii. 32 | 35 | S | 6·29 | 8,700 |
| 830 | 19. ii. 32 | 114 | A | 5·13 | 15,100 |
| 1024 | 17. xi. 32 | 36 | S | 4·80 | 300 |
| 1025 | 17. xi. 32 | 12 | S | 5·02 | 300 |
| 1026 | 18. xi. 32 | 33 | S | 4·60 | 1,200 |
| 1117 | 7. ii. 33 | 5 | S | 4·37 | 300 |
| 1118 | 8. ii. 33 | 70 | S | 6·33 | 600 |
| 1119 | 8. ii. 33 | 90 | S | 6·63 | 300 |
| 1123 | 20. ii. 33 | 40 | A | 5·10 | 4,480 |
| 1124 | 21. ii. 33 | 95 | A | 5·44 | 2,400 |
| 1125 | 21. ii. 33 | 115 | A | 4·38 | 300 |
| 1233 | 28/29. xii. 33 | 108 | S | 4·75 | 3,240 |
| 1234 | 29/30. xii. 33 | 5 | A | 2·83 | 4,000 |
| 1323 | 27. iii. 34 | 180 | S | 6·85 | 300 |
| 1324 | 28. iii. 34 | 80 | S | 6·05 | 4,200 |
| 1325 | 28. iii. 34 | 10 | A | 6·02 | 3,300 |
| 1334 | 6. iv. 34 | 125 | A | 2·64 | 3,900 |
| 1335 | 6/7. iv. 34 | 104 | A | 3·17 | 10,500 |
| 1336 | 7. iv. 34 | 108 | A | 3·12 | 1,200 |
| 1337 | 7. iv. 34 | 130 | A | 3·60 | 600 |
| 1339 | 8. iv. 34 | 95 | A | 3·60 | 500 |
| 1425 | 26. ix. 34 | 55 | A | 1·62 | 2,700 |
| 1431 | 1. x. 34 | 80 | A | 1·92 | 3,300 |
| 1432 | 2. x. 34 | 55 | A | 0·81 | 5,400 |
| 1433 | 2. x. 34 | 55 | A | 0·83 | 800 |
| 1434 | 3. x. 34 | 113 | A | 0·97 | 1,800 |
| 1438 | 10. x. 34 | 135 | A | 0·74 | 900 |
| 1439 | 11. x. 34 | 47 | A | 0·95 | 2,100 |
| 1495 | 25. i. 35 | 108 | A | 4·33 | 5,400 |
| 1496 | 26/27. i. 35 | 90 | A | 2·40 | 1,500 |

abundance in late summer or autumn, after the main diatom flowering has passed its peak. Examples are *R. styliformis* in the northern hemisphere, and *R. polydactyla*, *R. chunnii* and *R. antarctica* (somewhat farther south) in the southern. This may be in some way connected with the variation in intensity and duration of light, for the other environmental factors are vastly different in corresponding latitudes in the two hemispheres.

## OBSERVATIONS IN THE SOUTH ATLANTIC OCEAN

Our findings of *R. curvata* in the South Atlantic Ocean east of South Georgia are shown in Fig. 2, while particulars from each station will be found in Table III below.

Table III. *Observations in the South Atlantic Ocean*

| Station | Date | Approx. distance from average position of convergence miles | On Antarctic (A) or sub-Antarctic (S) side of convergence | Surface temp. °C. | No. of *R. curvata* per haul |
|---|---|---|---|---|---|
| 670 | 22. iv. 31 | 270 | S | 8·10 | 300 |
| 1052 | 2. xii. 32 | 200 | A | 1·00 | 600 |
| 1053 | 3. xii. 32 | 125 | A | 2·15 | 4800 |
| 1054 | 3. xii. 32 | 65 | A | 2·91 | 2400 |
| 1162 | 21. iii. 33 | 80 | S | 6·00 | 1500 |
| 1190 | 21/22. xi. 33 | 180 | S | 7·36 | 300 |
| 1191 | 22. xi. 33 | 170 | S | 4·97 | 300 |
| 1192 | 22. xi. 33 | 190 | S | 5·24 | 300 |
| 1194 | 23. xi. 33 | 144 | S | 5·47 | 300 |
| 1195 | 23. xi. 33 | 125 | S | 5·58 | 300 |
| 1197 | 24/25. xi. 33 | 55 | S | 3·00 | 6000 |
| 1381 | 10.viii.34 | 60 | A | 2·60 | 2400 |
| 1382 | 11.viii.34 | 130 | A | 1·26 | 1200 |
| 1391 | 21.viii.34 | 60 | S | 2·70 | 300 |

Unfortunately our data from this area are more scanty than from any other, apart from the middle of the Southern Indian and Pacific Oceans. As will be seen later, the observations are well distributed over the greater part of those sectors, but they are not so here. The outstanding feature of these records is the relatively large numbers of the species obtained at some stations south of the Antarctic convergence, while relatively poor catches were obtained to the north. This is at variance with the claim that the species reaches its optimum in the sub-Antarctic Zone. It will be readily seen from Table III, however, that not only were all the numbers recorded below the average, but that the sub-Antarctic records from this area were, with one exception, obtained during the months when the species has never been found abundantly. These facts go far towards explaining the apparent anomaly, for the relatively abundant southerly records were obtained at different times of year, when the data from the sub-Antarctic Zone in this sector are inadequate.

The unusual southward extension of the species at Sts. 1052–1054 was almost certainly due in part to mixing from across the convergence, which is known to be particularly unstable in this position. It is very unfortunate that no observations north of the convergence at that time are available. At the winter stations 1381 and 1382 the probability of southward mixing is strong. The normal direction of the surface drift is known to be reversed at times during the coldest months of the year, and the surface temperature of 2·60° C. at St. 1381 is so high for its position at the time it was worked as to be virtually impossible unless this factor was operating. It will be seen that at St. 1391, worked only 10 days later at a similar distance on the opposite (sub-Antarctic) side of the convergence, the temperature was only 0·10° C. higher.

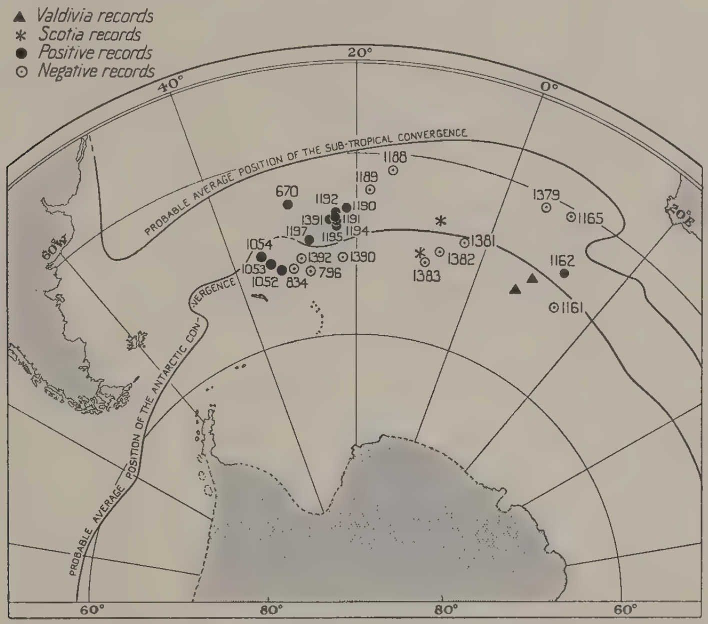
▲ Valdivia records
* Scotia records
● Positive records
⊙ Negative records
20°
40°
0°
60°
20°
PROBABLE AVERAGE POSITION OF THE SUB-TROPICAL CONVERGENCE
PROBABLE AVERAGE POSITION OF THE ANTARCTIC CONVERGENCE
1188
1189
670
1192
1190
1391
1191
1197
1195
1194
1054
1392
1390
1053
796
1052
834
1379
1165
1381
1382
1383
1162
1161
60°
80°
80°
60°

Fig. 2. Observations of *Rhizosolenia curvata* in the South Atlantic Ocean.

The richest catch from our meagre South Atlantic collection was obtained at St. 1197 on the sub-Antarctic side of the convergence. Another station of special interest is 670 which furnishes one of the very few records (only three in all) of the occurrence of *R. curvata* at temperatures higher than 8° C.

## OBSERVATIONS IN THE SOUTHERN INDIAN OCEAN AND SOUTH OF AUSTRALIA

Our records of *R. curvata* for this area are not very numerous, but the majority were obtained on series of observations running more or less north and south through the full width of the sub-Antarctic Zone. The data thus provided were, therefore, particularly well suited to the purpose of this study, and will be seen to agree almost perfectly with the general theory of the distribution of the species. The results are shown in Table IV, and the positions of the stations have been plotted in Fig. 3.

All the larger hauls of *R. curvata* in this sector occurred in the sub-Antarctic Zone, except at St. 883, where Deacon (1937) has already been able to demonstrate a direct southward movement of surface water by hydrological criteria. Deacon also considered that conditions at St. 891, even farther within the normal limits of the Antarctic Zone, were indicative of the operation of this same factor. This reversal of the normal direction of the surface drift is believed by Deacon to be a fairly frequent occurrence during the coldest months of the year.

Table IV. *Observations in the Southern Indian Ocean and south of Australia*

| Station | Date | Approx. distance from average position of convergence miles | On Antarctic (A) or sub-Antarctic (S) side of convergence | Surface temp. ° C. | No. of *R. curvata* per haul |
|---|---|---|---|---|---|
| 848 | 12/13. iv. 32 | 240 | S | 6·97 | 7,100 |
| 849 | 14. iv. 32 | 100 | S | 7·72 | 300 |
| 863 | 29/30. iv. 32 | 60 | A | 1·97 | 300 |
| 866 | 1/2. v. 32 | 40 | S | 3·60 | 500 |
| 867 | 2/3. v. 32 | 125 | S | 5·36 | 400 |
| 868 | 3. v. 32 | 260 | S | 6·61 | 400 |
| 881 | 21. v. 32 | 280 | S | 8·30 | 300 |
| 882 | 22. v. 32 | 120 | S | 5·05 | 22,000 |
| 883 | 23. v. 32 | 58 | A | 3·72 | 7,300 |
| 891 | 30/31. v. 32 | 115 | A | 3·09 | 1,100 |
| 892 | 31. v. 32 | 95 | S | 5·00 | 4,300 |
| 893 | 1/2. vi. 32 | 285 | S | 7·91 | 1,200 |
| 1367 | 15. v. 34 | 62 | S | 4·38 | 2,100 |
| 1368 | 16. v. 34 | 230 | S | 7·54 | 9,300 |

Two other points of interest arise from consideration of these results. Firstly, it can be seen from Table IV that while the largest hauls were obtained from stations worked in the sub-Antarctic surface water towards the upper limit of the temperature range of the species, at the highest temperatures of all, at Sts. 849, 881 and 893, the falling off in numbers is very distinct. This tallies perfectly with the results obtained from the Southern Ocean as a whole, which show that quite close to the upper limit of its temperature range, *R. curvata* exhibits a marked decrease in numbers and in the size of the individuals. Secondly, there is a strong suggestion of a slight secondary autumnal maximum in the numbers of this never very abundant species, furnished by the relatively rich hauls at Sts. 882, 883 and 1368. This again has been found to hold for the Southern Ocean as a whole, but it is not nearly so well marked when all the areas, each with its own local variations in environment, are considered together.

## OBSERVATIONS SOUTH OF THE TASMAN SEA AND IN THE SOUTHERN PACIFIC OCEAN

Our records of *R. curvata* from this area are mostly from its eastern and western extremes. In the central part of the Southern Pacific Ocean very few stations have been worked in the sub-Antarctic Zone, and these at the least favourable time of the year, when the species is known to show its minimum abundance elsewhere. In plotting the positions of the stations it was found impossible to include all our observations in 80° W longitude, for they lie too close together to be shown on a chart of manageable scale. The repeated series have, therefore, been treated separately in Fig. 5, though one of them (Sts. 985–991) is shown on the general distribution chart (Fig. 4) in order to facilitate comparison with the results obtained elsewhere. Particulars of all the other positive records shown in Fig. 4 will be found in Table V. The observations in longitude 80° W are treated separately in Table VI.

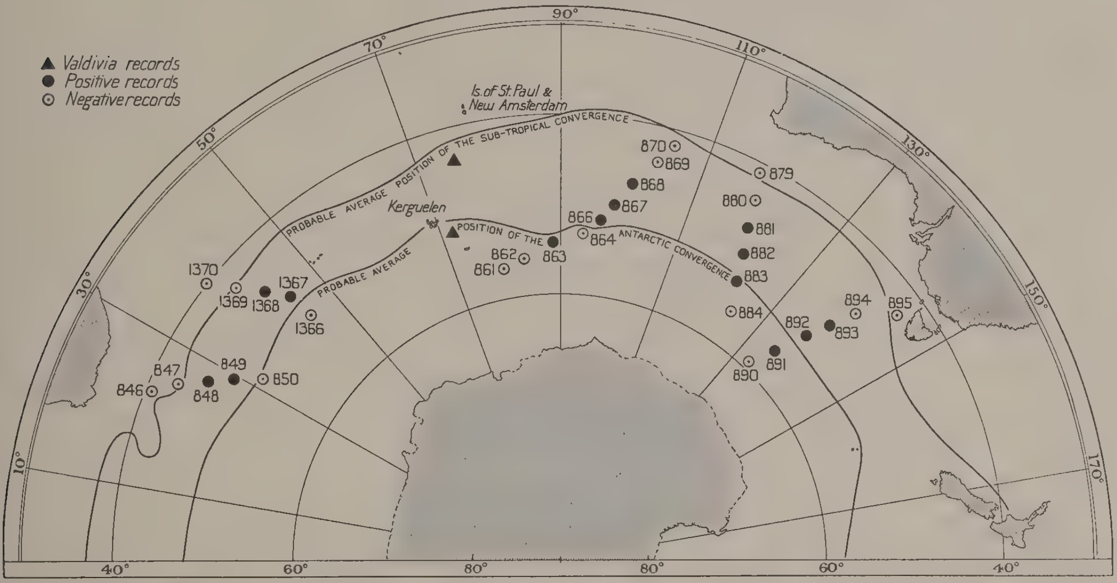
▲ Valdivia records
● Positive records
⊙ Negative records
90°
70°
110°
50°
130°
30°
150°
10°
170°
Is. of St. Paul & New Amsterdam
PROBABLE AVERAGE POSITION OF THE SUB-TROPICAL CONVERGENCE
Kerguelen
POSITION OF THE ANTARCTIC CONVERGENCE
PROBABLE AVERAGE
870
869
868
867
866
864
863
862
861
879
880
881
882
883
884
894
895
892
893
891
890
1370
1369
1368
1367
1366
847
846
848
849
850
40°
60°
80°
80°
60°
40°

Fig. 3. Observations of *Rhizosolenia curvata* in the Southern Indian Ocean and south of Australia.

The majority of the records south of the Tasman Sea and in the western portion of the Southern Pacific Ocean show few exceptions to the general theory of the distribution of *R. curvata* developed in other areas. In general the richer catches were obtained at sub-Antarctic stations at fairly high temperatures for the species, while at the one exceptionally warm station (922) the species was rare. All the records of the species on the Antarctic side of the convergence lie within the probable limit of occasional mixing. Mr Clowes informs me that between Sts. 1274 and 1276, which were worked in summer when southward mixing is less likely to occur, the convergence was unusually ill-defined.

When we come to examine the records from the eastern portion of the Southern Pacific Ocean, we find that while the species showed a normal distribution on the series of observations in longitude 80° W, it was present in considerable numbers at a small group of stations lying between 90 and 220 miles south of the probable average position of the convergence farther to the westward. These stations are anomalous. Unfortunately they represent the most northerly points reached during a fortnight's work, the bulk of which was carried out much farther to the southward, beyond the range of the species, so that it is only possible to put forward a tentative explanation. I believe it possible that even the extreme southern record may be attributed to exceptional mixing, for prior to and during the period in which Sts. 1466, 1469 and 1470 were worked, strong northerly winds, reaching gale force, were experienced.[1]

Table V. *Observations south of the Tasman Sea and in the Southern Pacific Ocean* (Fig. 4)

| Station | Date | Approx. distance from average position of convergence miles | On Antarctic (A) or sub-Antarctic (S) side of convergence | Surface temp. ° C. | No. of *R. curvata* per haul |
|---|---|---|---|---|---|
| 730 | 20. xi. 31 | 90 | S | 3·24 | 4,500 |
| 731 | 20. xi. 31 | 40 | S | 1·81 | 2,700 |
| 732 | 21. xi. 31 | 49 | A | 1·66 | 600 |
| 900 | 17/18. vi. 32 | 285 | S | 6·92 | 1,200 |
| 903 | 19/20. vi. 32 | 50 | S | 4·92 | 3,600 |
| 920 | 26. vi. 32 | 10 | A | 2·91 | 800 |
| 922 | 28. vi. 32 | 240 | S | 8·24 | 300 |
| 949 | 6/7. ix. 32 | 85 | S | 3·41 | 200 |
| 950 | 7/8. ix. 32 | 75 | A | 0·74 | 1,900 |
| 961 | 12. ix. 32 | 35 | A | 0·41 | 300 |
| 970 | 25. ix. 32 | 120 | S | 3·70 | 300 |
| 972 | 26. ix. 32 | 57 | A | 1·61 | 2,100 |
| 975 | 29. ix. 32 | 110 | A | 0·43 | 600 |
| 976 | 30. ix. 32 | 62 | S | 2·69 | 2,400 |
| 1274 | 21. i. 34 | 65 | A | 3·20 | 4,200 |
| 1276 | 22. i. 34 | 105 | S | 5·83 | 10,000 |
| 1453 | 1/2. xi. 34 | 90 | A | 1·22 | 6,900 |
| 1466 | 9. xi. 34 | 175 | A | 0·90 | 1,100 |
| 1469 | 12. xi. 34 | 125 | A | 1·11 | 5,400 |
| 1470 | 12. xi. 34 | 220 | A | −0·19 | 600 |

It may be mentioned that throughout the whole period of the cruise on which these stations were worked, the weather was exceptionally bad, and may reasonably be assumed to have favoured thorough mixing of the surface layers. As will be shown later, St. 1475, which was worked in longitude 80° W shortly after the stations discussed

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[1] During the first three days the wind rarely shifted more than two points either side of north, which is very unusual for strong winds in these latitudes. In the ordinary way the westerly component soon becomes predominant, and the gale usually finishes in the south-west. This particular blow did not shift beyond north-north-west until it moderated and held true in that quarter the day before St. 1470, which provides the most southerly record of our species, was worked. Actual wind records covering this period were as follows:

| Date | Time | Direction | Mean force knots | Incidence of critical Sts. |
|---|---|---|---|---|
| 7. xi. 34 | 0926–1012 | NNW | 10 | — |
| 9. xi. 34 | 0916–1334 | N × E/WNW | 16/20 | 1466 |
| 11. xi. 34 | 0935–1213 | NNW/NNW | 30/30 | — |
| 11. xi. 34 | 2113–2254 | WNW | 12 | — |
| 12. xi. 34 | 0908–1317 | WNW | 10 | 1469 |
| 12. xi. 34 | 2110–2254 | W × N | 20 | 1470 |

above, supplied one of the three records of *R. curvata* south of the actual position of the convergence in that longitude. This station also was preceded by two days of strong winds from due north, although they were not exceptionally violent. Though the hydrological evidence has not yet been worked up in detail, I am informed by Mr Clowes that in addition to the strong probability of direct surface drift due to these unusual wind conditions, the actual position of the Antarctic convergence may have been considerably south of the probable average position plotted in Fig. 4, at the time when the observations in question were taken.

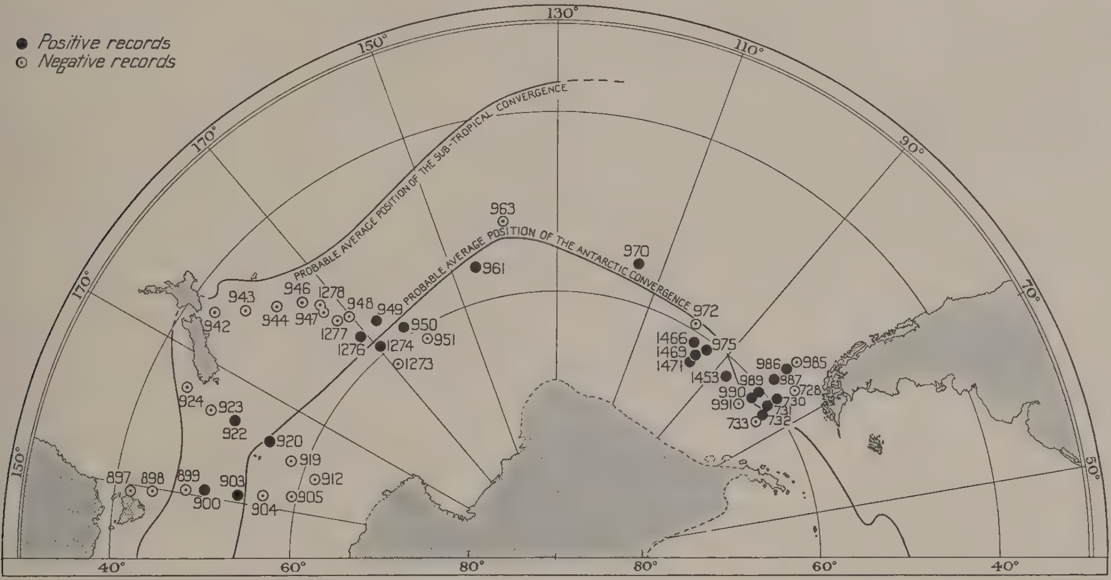
● Positive records
⊙ Negative records
130°
150°
110°
170°
90°
170°
70°
150°
50°
PROBABLE AVERAGE POSITION OF THE SUB-TROPICAL CONVERGENCE
PROBABLE AVERAGE POSITION OF THE ANTARCTIC CONVERGENCE
963
961
970
972
975
1466
1469
1471
1453
986
985
989
987
728
990
991
730
731
733
732
943
946
1278
948
949
942
944
947
1277
950
951
1276
1274
1273
924
923
922
920
919
912
897
898
899
903
900
904
905
40°
60°
80°
80°
60°
40°

Fig. 4. Observations of *Rhizosolenia curvata* south of the Tasman Sea and in the South Pacific Ocean.

Our findings of *R. curvata* on the repeated series of observations in 80° W longitude are shown diagrammatically in Fig. 5, and particulars of the stations at which positive records were made will be found in Table VI.

In Fig. 5 the probable average position of the convergence is shown by the continuous vertical line, and its probable actual position at the time when each individual series of observations was made by the arrows. I am indebted to Mr Clowes for the information upon which these positions are based, and he has asked me to state that further examination of the data may show that in March 1934 the convergence should have had a more northerly position assigned to it. The extreme "probable actual positions" are thought to represent quite fairly the extent of actual change in position of the convergence during a normal year. It will be seen in Fig. 5 that the extremes were reached in March and November 1934. With the aid of the meridional scale at the top of the diagram it can also be seen that the distance between these extremes is not great, barely 2° of latitude.

The observations in longitude 80° W present several features of special interest from

Table VI. *Results of the repeated series of observations in approximately 80° W longitude (Fig. 5)*

| Station | Date | Approx. distance from average position of convergence miles | On Antarctic (A) or sub-Antarctic (S) side of convergence | Surface temp. ° C. | No. of *R. curvata* per haul |
|---|---|---|---|---|---|
| 985 | 24. x. 32 | 410 | S | 4·96 | Not observed |
| 986 | 25. x. 32 | 255 | S | 4·89 | 300 |
| 987 | 26. x. 32 | 220 | S | 3·90 | 300 |
| 989 | 27. x. 32 | 80 | S | 3·43 | 1,200 |
| 990 | 27. x. 32 | 14 | S | 3·06 | 3,900 |
| 991 | 28. x. 32 | 62 | A | −0·39 | Not observed |
| 992 | 28. x. 32 | 129 | A | −1·53 | Not observed |
| 993 | 29. x. 32 | 208 | A | −1·87 | Not observed |
| 1221 | 14. xii. 33 | 250 | A | −0·83 | Not observed |
| 1222 | 14. xii. 33 | 172 | A | −0·55 | Not observed |
| 1223 | 15. xii. 33 | 82 | A | −0·05 | Not observed |
| 1224 | 15/16. xii. 33 | 0 | On convergence | 1·80 | 1,460 |
| 1225 | 16. xii. 33 | 76 | S | 3·32 | 18,900 |
| 1226 | 16. xii. 33 | 158 | S | 3·83 | 8,700 |
| 1227 | 17. xii. 33 | 210 | S | 4·13 | 24,900 |
| 1228 | 17. xii. 33 | 270 | S | 5·59 | 2,600 |
| 1229 | 18. xii. 33 | 418 | S | 6·50 | Not observed |
| 1313 | 11. iii. 34 | 230 | A | 1·19 | Not observed |
| 1314 | 11. iii. 34 | 140 | A | 1·41 | Not observed |
| 1315 | 12. iii. 34 | 45 | A | 4·01 | 3,300 |
| 1316 | 12. iii. 34 | 43 | S | 4·14 | 3,000 |
| 1317 | 13. iii. 34 | 135 | S | 5·14 | 2,600 |
| 1318 | 13. iii. 34 | 195 | S | 6·52 | 1,100 |
| 1319 | 14. iii. 34 | 263 | S | 6·75 | 200 |
| 1320 | 14. iii. 34 | 385 | S | 7·75 | Not observed |
| 1415 | 12. ix. 34 | 90 | A | −1·09 | Not observed |
| 1416 | 13. ix. 34 | 20 | A | −0·38 | 1,800 |
| 1417 | 13/14. ix. 34 | 65 | S | 1·82 | 4,800 |
| 1418 | 14. ix. 34 | 135 | S | 2·42 | 2,600 |
| 1419 | 14/15. ix. 34 | 220 | S | 2·86 | 2,300 |
| 1420 | 15. ix. 34 | 300 | S | 4·11 | 300 |
| 1421 | 15. ix. 34 | 360 | S | 4·94 | 600 |
| 1442 | 26. x. 34 | 260 | S | 4·50 | 600 |
| 1444 | 27. x. 34 | 180 | S | 3·55 | 2,400 |
| 1445 | 28. x. 34 | 120 | S | 3·51 | 3,000 |
| 1446 | 28. x. 34 | 54 | S | 2·73 | 9,900 |
| 1447 | 29. x. 34 | 27 | A | −0·37 | Not observed |
| 1448 | 29. x. 34 | 94 | A | −1·16 | Not observed |
| 1449 | 30. x. 34 | 170 | A | −1·62 | Not observed |
| 1473 | 15. xi. 34 | 97 | A | −1·15 | Not observed |
| 1474 | 16. xi. 34 | 40 | A | −0·82 | Not observed |
| 1475 | 16. xi. 34 | 5 | S | 0·40 | 300 |
| 1476 | 17. xi. 34 | 110 | S | 2·73 | 2,400 |

the point of view of this study. The complications induced by the land masses when the main westerly drift of the Southern Ocean flows through Drake Passage to the eastward are responsible for the great southward extension of the sub-Antarctic surface water in this region. As a result the Antarctic convergence in the eastern South Pacific is found more than 5° farther to the southward than in any other sector. The great difference in latitude enables true sub-Antarctic surface water to reach much lower temperatures here than elsewhere, and provides the explanation of most of the differences between such data as are recorded in Table VI and those from other areas. Thus at St. 1417, where *R. curvata* was found in its maximum numbers in September 1934, the surface temperature was only 1·82° C., which in any other area would immediately lead one to suspect that the water was mainly of Antarctic origin. As indicated in Fig. 5, however,

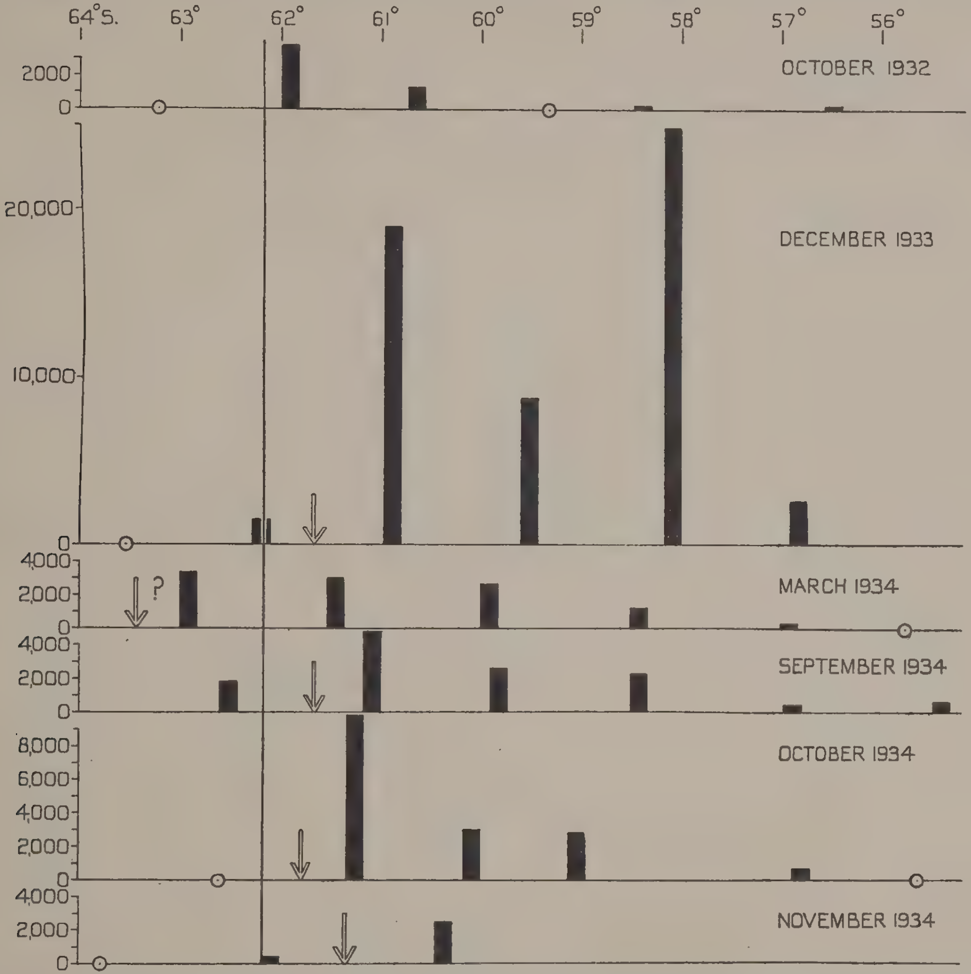

Fig. 5. Observations of *Rhizosolenia curvata* in longitude 80° W. The continuous vertical line represents the average position of the Antarctic convergence, and the arrows its probable actual position during each series of observations.

it lay 65 miles north of the average position of the convergence, and 35 miles north of its probable actual position at the time when the observations were made. There is thus no doubt of the mainly sub-Antarctic composition of the surface water there.

The differences noted between the "probable average" and probable actual positions of the convergence show clearly the difficulties introduced by quite small variations in the position of the convergence into comparisons of the type presented in this paper. It is impossible to give more exact data than the probable average position plotted on the distribution charts, except where very full series of observations normal to the isotherms are available, as here. A similar anomaly is shown by the figures for St. 1475, where small numbers of *R. curvata* were obtained. Here the very low surface temperature, 0·40° C., was sufficient to show, even in the eastern South Pacific, that the degree of sub-Antarctic mixing, due to strong northerly winds prevalent at the time, was but slight. Yet this station lay on the sub-Antarctic side of the average position of the convergence. The *actual* position of the convergence at the time, however, lay 45 miles to the north, and so the apparent anomaly explains itself.

Apart from these indications of the probable sources of discrepancies in the more widely scattered data from other areas, the broad significance of these records in longitude 80° W is quite clear. They give strong support to the general theory of the distribution of *R. curvata* which cannot be postulated so definitely for the less well-worked areas. Thus all the heavier catches were in sub-Antarctic water, for on the only occasion upon which a considerable haul was obtained south of the average position of the convergence, it seemed highly probable that the convergence had actually shifted even farther south (cf. the relatively high surface temperature at St. 1315).

In the other areas investigated all the way round the world, the most southerly records of *R. curvata* lie well north of latitude 60° S. In the eastern South Pacific, in longitude 80° W and at Sts. 730 and 1466 for example, records south of 60° S are common. Reference to Fig. 7 in the concluding section of this paper, where nearly all the records have been plotted on a circumpolar chart, will show at once how closely this great southward extension of the species is correlated with the southward sweep of the convergence where it rounds Cape Horn.

The observations in longitude 80° W also show that in five out of six successive series of observations the maximum numbers of *R. curvata* were recorded at the stations immediately to the north of the convergence. This lends very strong support to the view that it is in the colder portion of the sub-Antarctic Zone that the species finds its optimum. The fact that the highest numbers of all have been obtained at somewhat higher temperatures in the Scotia Sea and southern Indian Ocean does not detract from the value of this evidence. The more northerly position of the convergence and the fact that the sub-Antarctic Zone itself is much narrower in those regions leads to a crowding together of the isotherms. Actually, therefore, these very rich stations (e.g. Sts. WS 69, WS 520 and 882) are no farther from the convergence than the southerly stations in 80° W, and it is still quite correct to regard the former as lying within the colder part of the sub-Antarctic Zone. When it is added that the temperatures in the warmer part of the sub-Antarctic Zone range up to 14·5° C. in summer (Deacon, 1933, p. 206), and that *R. curvata* has only been recorded in very small numbers at five stations where the surface temperature was over 7·6° C. and never with certainty above 8·3° C., the force of this argument becomes even more apparent.

In the eastern South Pacific the sub-Antarctic Zone reaches its greatest width, through the agency of known geophysical factors, and it is here that *R. curvata* shows its greatest meridional range in terms of distance north of the Antarctic convergence. In terms of latitude of course, its northerly limit is reached in other areas where the convergence itself may lie as much as 800 miles farther north than it does in longitude 80° W.

## GENERAL BIOLOGY

The only inaccuracy in Zacharias's original description of *R. curvata* (1905, pp. 120–1) arises from the limitations of his material. He speaks of the species as being slender, and goes on to state that all his specimens (from a single sample) had diameters ranging from 51 to 57$\mu$ and varied between 850 and 1000$\mu$ in length. Karsten (1905, p. 97) gives 48–80$\mu$ as the diameter range and 572–900$\mu$ as the range in length. In the endeavour to establish the essentially sub-Antarctic habit of this species I undertook a very large number of measurements by the methods described on p. 420, this method of attack having been suggested by Wimpenny's recent work (1936). The variation in dimensions, especially in length, was enormous, and the work was concentrated on the more constant and significant diameter measurements. Even here I found an extreme range of 20–135$\mu$ and a normal range of 31–117$\mu$, while the mean of over 3000 measurements was 62·7$\mu$. Specimens 1500$\mu$ in length were not uncommon, and one 2000$\mu$ long was measured. The grosser individuals can certainly not be described as slender, for they do not reach the extremes in length very often, and are only rivalled in bulk by a few warm-water members of the genus such as *R. robusta* Norman, and by rarer sub-Antarctic species.

Apart from this question of the proportions of the individuals, nothing can be added to the early descriptions of the species by Zacharias and Karsten. Karsten's description is to be found under the synonym *R. curva* (1905, p. 97), and he gives admirable figures of the details of the cell structure (Taf. xi, figs. 2, 2 *b*). An attempt has been made to depict a typical individual in Plate XIV, fig. 1, while the outlines in figs. 2–4 are intended to give an idea of the size range of the species.

The typical habit of *R. curvata* is solitary; but since binary fission is by far the commonest method of reproduction, chains of two or three individuals are by no means rare. The largest number of individuals I have seen in one chain is six, and chains of more than three are rare in our samples. The way in which the frustules are united in catena is indicated in Plate XIV, fig. 8. Another very peculiar type of colonial attachment has been rarely observed in this species, represented by fig. 9 in the plate. I have termed this process "rafting". It will be seen that the individuals adhere together by their long axes, and unlike the individuals in the chains, which have never been known to differ from each other by more than 2$\mu$ in diameter, the individual frustules in these rafts are of very different sizes. Usually the smaller individuals lie along the convex sides of the larger ones. It may be mentioned that rather similar rafts of *R. semispina* have also been seen rarely in the Southern Ocean.

## REPRODUCTION

As already mentioned, the commonest method of reproduction of *R. curvata* is by binary fission, as in most other true solenoid diatoms. Continued binary fission, however, results in a gradual diminution of size of the individuals; and auxospore formation, by means of which their size is again increased, must sooner or later intervene or the species would die out. Auxospore formation is well known in other members of the genus such as *R. styliformis*, *R. alata* and *R. bidens*, but was rarely seen in our relatively scanty material of *R. curvata*. The measurement investigations described later show that it tends to take place most frequently at the height of summer, in December and January, and to a lesser extent in spring and early autumn. We have comparatively few observations from the optimum zone of the species at these times, which probably explains the scarcity of auxospores in our samples. A third method of reproduction, by the formation of microspores, is common in some solenoid diatoms (e.g. *Corethron criophilum* and *Rhizosolenia semispina*), but has not been observed in *R. curvata*. It is of interest to record, however, that in the course of working through this material I came across some very beautiful examples of microspore formation in *R. polydactyla*, a species with a similar but less restricted distribution. So far as I have been able to determine, microspore formation had not previously been seen in this species.

In *R. curvata* then, only two methods of reproduction, binary fission and auxospore formation, are known. When an individual frustule is about to divide, the endochrome accumulates in two ovoid masses towards the middle of the cell. At this point the minute granulations of the outer wall of the old frustule become indistinct, rendering it more transparent, and the intercalary bands also become much less readily visible. This stage is represented in Plate XIV, fig. 5. Later the inner apexes of the two new cells, each with its mucron, are clearly laid down before the outer wall of the end of the new frustule, which forms immediately within the old one, is nearly complete (Plate XIV, fig. 6). The old frustule breaks along one of the original intercalary bands, and often persists as an outer degenerating sheath long after fission has been completed, so that at one end of a solitary frustule a sort of collar can be seen. This is shown in Karsten's original figure of the species (1905, Taf. xi, fig. 2).

Auxospore formation cannot be followed so closely owing to the scarcity of examples of it in our material. It appears, however, that after central aggregation of the endochrome, similar to that observed in the first stages of binary fission, the old frustule suddenly breaks at one of the intercalary bands. From the broken end a much larger bag-like extension with plastic walls develops, which presumably takes on the characteristic shape and slowly becomes silicified, as in other solenoid diatoms where auxospore formation is well known. An auxospore of *R. curvata* is shown in Plate XIV, fig. 7.

The methods of reproduction adopted by *R. curvata* provide an important line of evidence as to the meaning of its observed distribution. Wimpenny's work on *R. styliformis* in the North Sea suggests that auxospores can only be formed near the upper limits of the organism's temperature range. It was for this reason that the measurement investigations shortly to be described were undertaken. With the species limited to these two methods of reproduction it is obvious that it cannot persist in an environment in which auxospore formation is impossible, though it may survive for a time by continued binary fission, with the cells getting ever smaller. Therefore if it could be shown that smaller individuals were present in marked excess at the cold stations south of the convergence, while larger individuals that could only have been the result of recent auxospore formation were relatively abundant at the warmer stations to the north, Wimpenny's generalization could be extended to this species, and lend powerful support to the view that the sub-Antarctic Zone is its proper habitat.

### SEASONAL VARIATION IN ABUNDANCE

Owing to the limitations of the data available, it is not possible to establish the seasonal variation in abundance of *R. curvata* with the certainty possible when dealing with common species from intensively studied areas. It was essential to endeavour to obtain some idea of the probable seasonal range in numbers, in order to be able to assess the value of the distributional variations observed. The available records have been grouped into month classes, and arithmetical means for each month calculated as follows:

Table VII. *Seasonal variation in abundance of* Rhizosolenia curvata

| Month | No. of observations | No. of *R. curvata* per haul |
|---|---|---|
| July | — | — |
| August | 3 | 1,300 |
| September | 14 | 1,635 |
| October | 14 | 2,565 |
| November | 23 | 1,740 |
| December | 15 | 5,100 |
| January | 5 | 4,310 |
| February | 16 | 26,240 |
| March | 19 | 3,760 |
| April | 9 | 2,745 |
| May | 13 | 3,730 |
| June | 5 | 1,420 |

In this table the months have been arranged so that July, corresponding seasonally to January in the northern hemisphere, comes first. The more obvious features of the seasonal variation indicated by these means agree so well with our general knowledge of plankton periodicity in the south, and the genus *Rhizosolenia* more particularly, that it seems certain that a useful approximation to the true order of frequency has been arrived at. Thus the low values recorded in the winter months June and August, when conditions for diatom growth are known to be very unfavourable, are in accordance with expectation. The slight increase in October, corresponding to April in the northern hemisphere, would also follow naturally. During the month of November most of the other southern diatom genera reach their great maxima in the northern part of the Antarctic Zone, and to a lesser extent in the southern part of the sub-Antarctic Zone—the true home of *R. curvata*—also. I believe therefore that the drop in the November figures may have a real significance, these essentially summer forms tending to be kept down by the vast numbers of other species present. The rise from mid-season onwards, with a well-marked maximum in February, is beyond doubt. If the two largest catches in this month are excluded, on the grounds of the exceptional conditions under which they were obtained, the mean figure is reduced to 11,270 and still remains more than twice as great as that for any other month. The slight difference between the December and January figures, on the other hand, is probably not significant, being due to insufficiency of data for the latter month, when the ships have nearly always been working too far south to capture the species.

The slight increase in May is probably a real one ensuring a sufficiency of individuals to maintain the stock through the unfavourable winter period when mortality is certainly high. Moreover, the measurement data indicate a high degree of auxospore formation during May, as will be seen from Table VIII.

It should be borne in mind that the counts of this never very abundant species, small as they are, are obtained from quite large fractions of the catch, and are very much more accurate than ordinary estimates of the whole sample, where the numbers of some species often run into millions.

## MEASUREMENT INVESTIGATION

The method of collection and presentation of the data on variation in size has already been fully described (pp. 420–21). The seasonal variation in percentage frequency of the different diameter classes is shown in Table VIII. The percentages of individuals of diameter less than 60μ is shown to the left, and the percentage of greater diameter in the right-hand column.

Table VIII. *Seasonal variation in size of* Rhizosolenia curvata

| Month | % less than 60μ diam. | % of individuals in each diameter class | | | | | | | | | | % greater than 60μ diam. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | <30μ | 30–39 | 40–49 | 50–59 | 60–69 | 70–79 | 80–89 | 90–99 | 100–109 | >110μ | |
| July | — | — | — | — | — | — | — | — | — | — | — | — |
| Aug.* | 69·22 | 7·70 | — | 38·45 | 23·07 | 15·38 | 7·70 | — | — | 7·70 | — | 30·78 |
| Sept. | 51·20 | — | 7·15 | 21·43 | 22·62 | 23·81 | 13·09 | 5·95 | 3·57 | 2·38 | — | 48·80 |
| Oct. | 63·55 | — | 16·10 | 23·72 | 23·73 | 14·41 | 6·78 | 4·24 | 7·63 | 2·54 | 0·85 | 36·45 |
| Nov. | 56·10 | — | 4·88 | 25·61 | 25·61 | 24·38 | 6·10 | 4·88 | 2·44 | 6·10 | — | 43·90 |
| Dec. | 36·45 | — | 0·49 | 6·90 | 29·06 | 29·06 | 16·76 | 5·42 | 7·39 | 1·47 | 3·45 | 63·55 |
| Jan. | 33·77 | — | 1·30 | 10·39 | 22·08 | 32·46 | 14·29 | 9·09 | 9·09 | — | 1·30 | 66·23 |
| Feb. | 51·66 | — | — | 20·00 | 31·66 | 25·00 | 6·66 | 5·00 | 3·34 | 3·34 | 5·00 | 48·34 |
| March | 45·83 | — | 4·17 | 9·72 | 31·94 | 29·17 | 11·11 | 2·78 | 2·78 | 8·33 | — | 54·17 |
| April | 61·97 | — | 4·23 | 25·35 | 32·39 | 15·49 | 4·23 | 7·04 | 7·04 | 2·82 | 1·41 | 38·03 |
| May* | 44·90 | — | 4·08 | 18·37 | 22·45 | 19·73 | 14·97 | 6·12 | 10·20 | 4·08 | — | 55·10 |
| June* | 54·16 | — | 8·33 | 12·50 | 33·33 | 29·17 | 16·67 | — | — | — | — | 45·84 |

* Data not strictly comparable.

From this table it can at once be seen that the proportion of large individuals was greatest in December–January and in May. In September also, although the large class did not quite reach 50 per cent of the population, the increase in the proportion of large individuals over the previous month was particularly noteworthy. This suggests that auxospore formation immediately precedes or accompanies each increase in numbers of the species, which, as has already been shown, occur in October, December–February, and May. In February, when it seems certain that the greatest numerical abundance of the species was reached, large individuals were not so common as in the preceding. If the individual diameter classes for February are considered, it can be seen that the largest was that composed of individuals of from 50 to 59$\mu$ diameter, just on the small side of the mean, but that individuals of the smallest class were altogether absent during that month. This strongly suggests that vegetative division was then at its maximum, following maximal auxospore formation in January. The predominance of individuals of the smallest classes in October and November, and in the winter months of June and August, is well marked; and it has been shown that at these times the species is either decreasing or present in minimal numbers, but the result for the winter months were derived perforce from data not strictly comparable with that given for the rest of the year.

The results of the attempted correlation between size and temperature are shown in Table IX, based on figures collected in the manner described on p. 421. The proportion of small individuals was highest at the lower temperatures, and again at the highest temperatures of all. *R. curvata* was recorded from three stations with temperatures above 8° C., but these did not furnish sufficient material to warrant the calculation of percentages and are not considered in the table. It was noteworthy, however, that at this extreme upper limit of the organism's temperature range, all the individuals measured were below 50$\mu$ in diameter. Large individuals predominate towards the upper limit of the organism's temperature range but not near the extreme upper limit. This secondary diminution in size at the highest temperatures that the organism can tolerate constitutes the only point of difference from the size/temperature relation that one would expect by analogy with Wimpenny's recent work (1936).

Table IX. *Size/temperature correlation in* Rhizosolenia curvata

| Temp. range ° C. | % less than 60$\mu$ diam. | % of individuals in each diameter class | | | | | | | | | | % greater than 60$\mu$ diam. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | <30$\mu$ | 30–39 | 40–49 | 50–59 | 60–69 | 70–79 | 80–89 | 90–99 | 100–109 | >110$\mu$ | |
| <0* | 63·62 | — | 9·10 | 27·26 | 27·26 | 18·18 | 9·10 | — | 9·10 | — | — | 36·38 |
| 0–1 | 66·04 | — | 11·32 | 24·53 | 30·19 | 11·32 | 9·43 | 1·89 | 9·43 | 1·89 | — | 33·96 |
| 1–2 | 59·91 | 0·94 | 6·67 | 21·93 | 30·47 | 23·91 | 5·71 | 4·76 | 1·90 | 3·81 | — | 40·09 |
| 2–3 | 53·15 | — | 8·11 | 20·72 | 24·32 | 19·81 | 12·61 | 3·61 | 5·41 | 3·61 | 1·80 | 46·85 |
| 3–4 | 47·74 | — | 4·50 | 14·41 | 28·83 | 24·79 | 12·61 | 4·50 | 5·86 | 2·25 | 2·25 | 52·26 |
| 4–5 | 33·85 | — | — | 4·72 | 29·13 | 27·57 | 14·96 | 8·66 | 11·02 | 2·37 | 1·57 | 66·15 |
| 5–6 | 35·00 | — | 1·67 | 15·00 | 18·33 | 40·00 | 11·66 | 5·00 | 5·00 | 1·67 | 1·67 | 65·00 |
| 6–7 | 41·00 | — | 6·00 | 9·00 | 26·00 | 32·00 | 9·00 | 4·00 | 9·00 | 5·00 | — | 59·00 |
| 7–8 | 53·00 | — | 2·00 | 26·00 | 25·00 | 18·00 | 19·00 | 7·00 | 3·00 | — | — | 47·00 |

* Data not strictly comparable.

It is obvious that this evidence strongly supports the view that the species finds its optimum in the more southerly portion of the sub-Antarctic Zone. This is also confirmed by the numbers of individuals recorded at different temperatures. Fig. 6 shows the mean numbers of *R. curvata* per net haul for each degree of temperature. Still further support is furnished by the number of positive records obtained at the various temperatures. While the extreme range was – 0·40 to 8·30° C., 72 per cent of our positive records come from samples obtained in waters between 2 and 7° C.; that is, within the normal seasonal range of the southern part of the sub-Antarctic Zone.

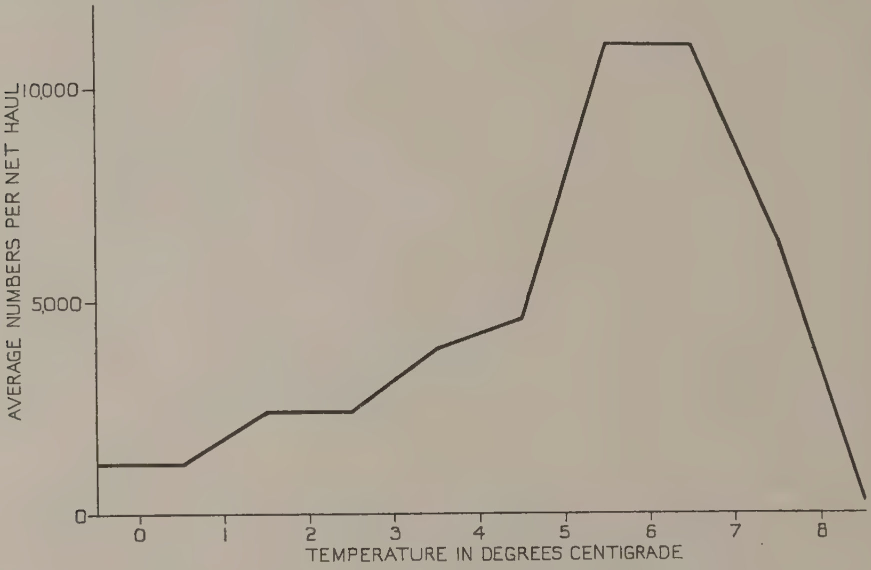

Fig. 6. Variation in abundance of *Rhizosolenia curvata* at different temperatures.

## PHYTOPLANKTON COMMUNITIES IN WHICH *RHIZOSOLENIA CURVATA* IS USUALLY FOUND

By far the most characteristic phytoplankton community of the convergence region as a whole is a "solenoid" community. The fullest development of this was seen in what I described as a "*Rhizosolenia* plankton" on the basis of earlier work in the Scotia Sea (Hart, 1934, p. 74). It has some points of resemblance to the styliplankton of the temperate zone in the northern hemisphere (Gran, 1912, p. 347). In this southern solenoid community *R. curvata*, although as a rule it is present only in relatively small numbers, is the only species that lends itself to use as an indicator. The others all have a wider distribution, a very much higher seasonal variation, while one species at least is almost completely cosmopolitan. The predominant members of the fluctuating solenoid community are:

| | |
|---|---|
| *Rhizosolenia polydactyla* Castracane | *Corethron criophilum* Castracane (*inerme* phase) |
| *R. alata* Brightwell (large phases) | *Dactyliosolen antarcticus* Castracane |

Where the mixing with water from the Antarctic side of the convergence is strongest these are replaced to an extent varying with the time of year by more southerly forms, of which the chief are:

*Fragilariopsis antarctica* (Castracane) Hendey
*Nitzschia seriata* Cleve[1]
*Asteromphalus regularis* Karsten
*Asteromphalus challengerensis* Castracane
*Thalassiothrix antarctica* (Schimper *ex* Karsten)

Where *Rhizosolenia curvata* has been swept south of the convergence by local reversal of the usual surface drift it usually finds itself in a community of these forms, together with both the common southern phases of *Corethron criophilum*. Sometimes where the mixing has been strong *Rhizosolenia polydactyla* may be quite numerous south of the convergence, but it is not so good an indicator as *R. curvata* owing to its much more irregular distribution in time and space.

In autumn, in the convergence region, the solenoid plankton is less well defined and *Ceratium pentagonum* Gourret becomes important. Sometimes when the phytoplankton is very sparse *Rhizosolenia curvata* becomes numerically dominant in late autumn. Near the northern limit of its range it is sometimes found along with *Ceratium fusus* Ehrenberg and other less numerous forms whose proper habitat is the warmer part of the sub-Antarctic Zone, such as various phases of *Ceratium tripos* O. F. Müller.

## CONCLUSIONS

On the basis of the evidence described in this paper it is concluded that *Rhizosolenia curvata* is a typically sub-Antarctic oceanic plankton diatom, mainly confined to the colder portion of the sub-Antarctic Zone. It is frequently carried across the Antarctic convergence when mixing of the surface waters occurs, and may survive for a short time in the mixed water, reproducing by vegetative division only. The rarity of large individuals, such as would result from recent auxospore formation, on the Antarctic side of the convergence, suggests that it could never persist there, for the sub-Antarctic element in the mixed water becomes cooled and dissipated rapidly, while the biological environment is also very different. It is thought that the occurrence of this species on the Antarctic side of the convergence is a good indication that mixing is in progress or has very recently taken place. The usual causes of such mixing are local wind currents in the warmer months of the year, and local reversal of the usual north-easterly surface drift, due to the sinking of intensely cooled surface water to the southward, in winter.

The probable exceptions to this rule arise in the few areas (e.g. South Georgia) where shoal water at no great distance south of the convergence may lead to vertical mixing, and thus to reappearance at the surface of individuals that have been carried south in the sub-surface current of the warm deep water.

Fig. 7 may be taken as a summary of the distributional evidence, it includes nearly all the positive records of the species, and the more significant negative observations. The only records omitted are the few small hauls round South Georgia, and a few from the

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[1] Nearly cosmopolitan, but reaching its maximum numbers in the Southern Ocean within the Antarctic Zone.

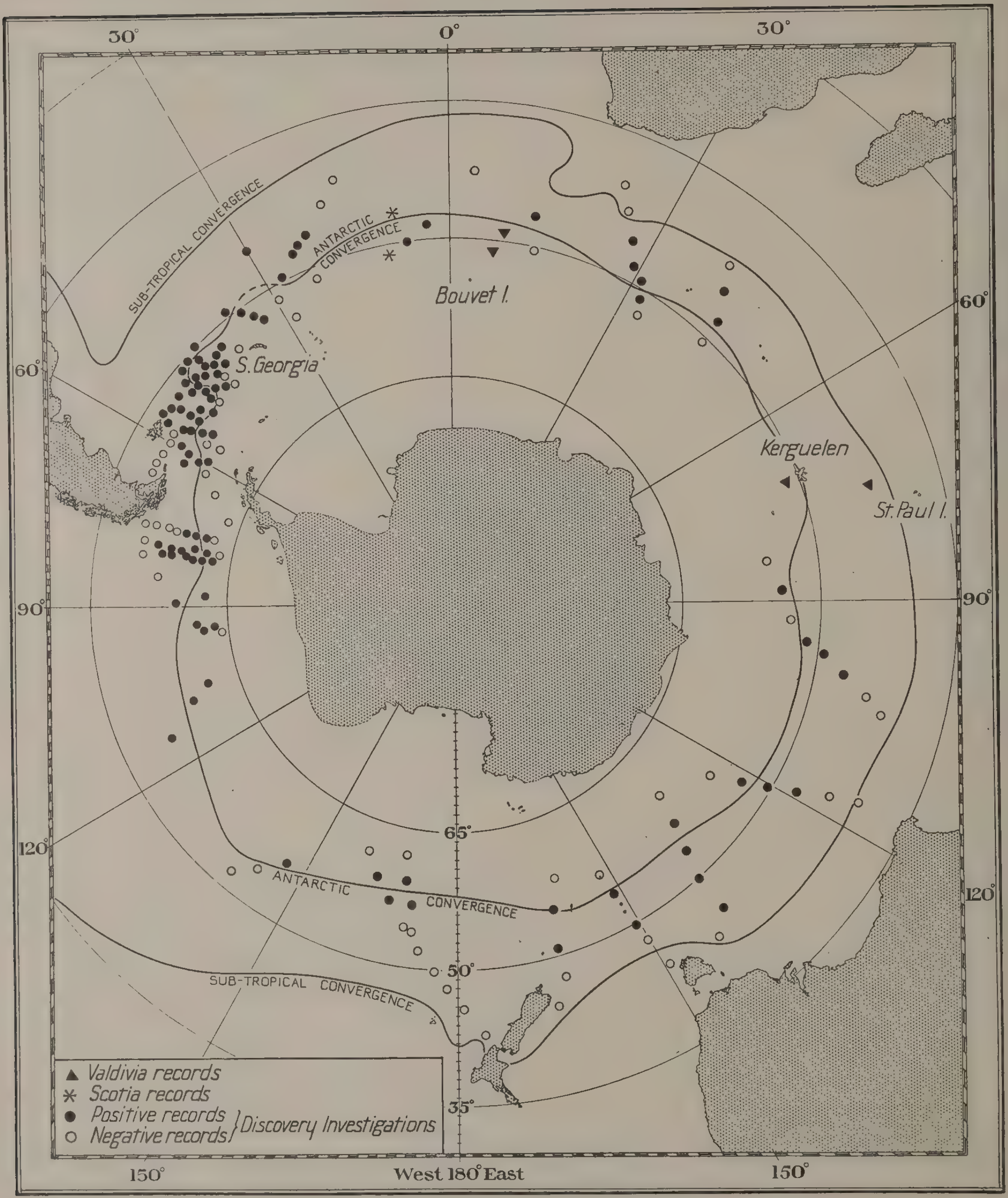
30°
0°
30°
60°
60°
90°
90°
120°
120°
150°
West 180° East
150°
65°
50°
35°
SUB-TROPICAL CONVERGENCE
ANTARCTIC CONVERGENCE
Bouvet I.
S. Georgia
Kerguelen
St. Paul I.
ANTARCTIC
CONVERGENCE
SUB-TROPICAL CONVERGENCE
▲ Valdivia records
✳ Scotia records
● Positive records
○ Negative records
Discovery Investigations

Fig. 7. General distribution chart of *Rhizosolenia curvata*, including all positive records except those round South Georgia and a few omitted to facilitate plotting, together with the more significant negative records.

more closely worked areas in the Scotia Sea and in longitude 80° W. It is impossible to include all these on a chart of this scale without overlapping.

The direct application of the evidence accumulated by measurements and estimates of the numbers in the net hauls to the problem of the distribution of the organism is shown in Table X. Here the observations have been grouped according to their distance from the average position of the Antarctic convergence. The percentage frequencies of the different diameter classes of *R. curvata* have been calculated by the methods already described, while the average number of individuals per net haul is shown in the right-hand column.

Table X. *Size variation and relative abundance of* Rhizosolenia curvata *at different distances from the Antarctic convergence*

| Distance range | % less than $60\mu$ diam. | % of individuals in each diameter class | | | | | | | | | | % greater than $60\mu$ diam. | Mean no. per net haul |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $<29\mu$ | 30–39 | 40–49 | 50–59 | 60–69 | 70–79 | 80–89 | 90–99 | 100–109 | $>110\mu$ | | |
| 100–200 miles south | 56·86 | 0·67 | 9·59 | 15·07 | 31·51 | 16·44 | 6·16 | 8·90 | 7·53 | 2·74 | 1·37 | 43·14 | 3570 |
| 100 miles south to convergence | 50·90 | — | 2·39 | 22·16 | 26·35 | 22·16 | 10·78 | 7·78 | 3·59 | 1·80 | 2·99 | 49·10 | 4050 |
| Convergence to 100 miles north | 46·08 | 0·43 | 4·35 | 17·17 | 24·13 | 23·27 | 13·91 | 5·65 | 6·30 | 3·04 | 1·74 | 53·92 | 8150 |
| 100–200 miles north | 43·25 | — | 5·12 | 17·20 | 20·93 | 23·26 | 17·67 | 3·26 | 7·44 | 5·12 | — | 56·75 | 7960 |
| 200–300 miles north | 42·47 | — | 2·65 | 13·27 | 26·55 | 30·97 | 7·96 | 6·19 | 8·87 | 1·77 | 1·77 | 57·53 | 5950 |

It may be added that records of the species were obtained at four stations north of the distance scale shown in the table. At these the mean diameter of the individuals was only $54\mu$ and their average number only 450 per net haul. Evidently the normal limit of the species on the sub-Antarctic side of the convergence is about 300 miles, and from the temperature records discussed in earlier sections it seems probable that this will be found to coincide roughly with the 8·5° isotherm, except in the eastern South Pacific.

It is obvious that the size frequency distribution shown in Table X should be a broad reflection of the size temperature correlation already demonstrated, but it is bound to be somewhat masked by seasonal effects. However, it is sufficiently clear that the highest proportion of small individuals was recorded at those stations farthest on the Antarctic side of the convergence, while the largest proportion of large individuals was found in the sub-Antarctic Zone. The small fluctuations in the actual position of the convergence probably account for the proportion of large individuals found immediately to the south of it being larger than the theory ideally demands. It will be readily appreciated that in drawing up a general comparison such as this, it has only been possible to consider the "probable average" position of the convergence.

Wimpenny (1936) and Hendey (1936), as a result of their work on phytoplankton from very different aspects, have been led to conclude that the size/temperature relation of marine plankton diatoms is the reverse of that which has long been known to exist in many classes of marine animals. The latter almost invariably provide large individuals of the same species in colder waters. It is in warm seas that the volume of marine plankton diatoms appears to be greatest, with consequent reduction of the surface volume ratio. Wimpenny's work on *R. styliformis* in the North Sea shows that this relation holds true for that species with great consistency over the temperature range he was able to investigate.

It will be realized that the size/temperature correlation we have been able to trace in *R. curvata* agrees perfectly with this theory, until a point near the extreme upper limit of the organism's temperature range is reached, when the size again decreases. Smaller individuals of *R. curvata* undoubtedly predominated towards the colder limit of its range, where I believe that auxospore formation is impossible for this species.

The relation is particularly easy to visualize in terms of almost perfectly cylindrical solenoid diatoms. If one considers two cylinders of equal volume, one twice the length of the other, a simple calculation will show that the diameter of the long thin one is only $\frac{1}{\sqrt{2}}$ times smaller than that of the stouter individual. The surface area of the longer cylinder will however be greater than that of the stouter one in the proportion of $\sqrt{2}:1$. In nature the more slender individuals of the species studied are never long enough to equal the stouter ones in volume, so that the increase in surface/volume ratio will be even more marked. This seems highly significant in view of Hendey's conclusion that cold water marine plankton diatoms in general tend to develop an elongated tubular habit.

It appears possible that this tendency—increased surface area at colder temperatures, and conversely decreased surface area at warmer temperatures—will be found to be correlated with a necessity for maintaining a constant amount of metabolism within the individual organism. It is obvious that so long as the surface/volume ratio remains the same, the amount of metabolism will vary with the rate, i.e. directly with the temperature. It may well be that some such method of meeting increased rate of metabolism is essential to warm-water species inhabiting media with a relatively poor supply of nutrient materials.

This, however, brings us to another factor which will probably be found to have a complicating influence on the size/temperature relations of marine plankton diatoms—nutrient ion concentration. I have not been able to follow it up in the present work, as data relating to nutrient salts are not available at a sufficient number of the stations at which *R. curvata* was found, and being a rare species, numerically speaking, it would not be suitable for such a study. It seems to me to be very significant, however, that all the localities where large diatom species have been recorded from the tropics are near known centres of upwelling, and consequent relatively high nutrient ion concentration. Recent work of Peters (1932) has shown that *Ceratia* reach their size maxima in these areas, but as they are an essentially warm water genus, it may be unwise to stress unduly the similarity of their size distribution to that of plankton diatoms.

If the main hypothesis concerning the distribution of *Rhizosolenia curvata* examined in the work described in this paper is accepted, a question of great interest immediately presents itself. How is this passively drifting holophytic organism able to maintain itself within the narrow limits of the colder portion of the sub-Antarctic Zone, where it apparently finds its optimum? That some of the individuals temporarily driven into the Antarctic Zone eventually find their way back again is highly probable, for the surface drift is known to have a northerly component. It is the limited distribution of the species to the north of the Antarctic convergence that demands explanation, for the main trend of the surface drift, apart from local interruptions such as have been described, has a northerly component in the sub-Antarctic Zone also. We have seen that the organism is sometimes carried far south of its proper habitat by subsurface transportation in the warm deep water. This, however, could not help to maintain it in its ideal environment, owing to the much greater depth at which the warm deep water lies in the sub-Antarctic Zone, and in the absence of land masses in the convergence region to cause upwelling on a large enough scale to complete the return journey by such an agency. Eddy action in the turbulent region of mixed surface water immediately to the north of the convergence may well provide a partial explanation, but does not account for the regular occurrence of the species in relatively large numbers more than 100 miles north of the convergence and its absence in the northern part of the sub-Antarctic Zone.

An adequate answer to the question appears to me, however, to be supplied by Deacon (1933, p. 207). He has been able to demonstrate that in the South Atlantic not only does the sub-Antarctic surface water tend to sink in about 45° S, but that there is a shallow southward-flowing subsurface current which would readily mix with the surface layers on reaching the turbulent areas immediately to the north of the Antarctic convergence. A hydrological system such as this exactly fits in with the known distribution of *R. curvata* in the southern ocean, if we are permitted to assume that, like other members of the genus, it is able to survive for considerable periods below the photic zone in a resting condition.

If the probable value of *R. curvata* as an indicator of the extent of sub-Antarctic influence to the south of the average position of the convergence is admitted, it appears that it is in the region of the S-shaped bend in the Scotia Sea that the position of the Antarctic convergence is most variable, and that it is there that mixing across the convergence takes place most frequently.

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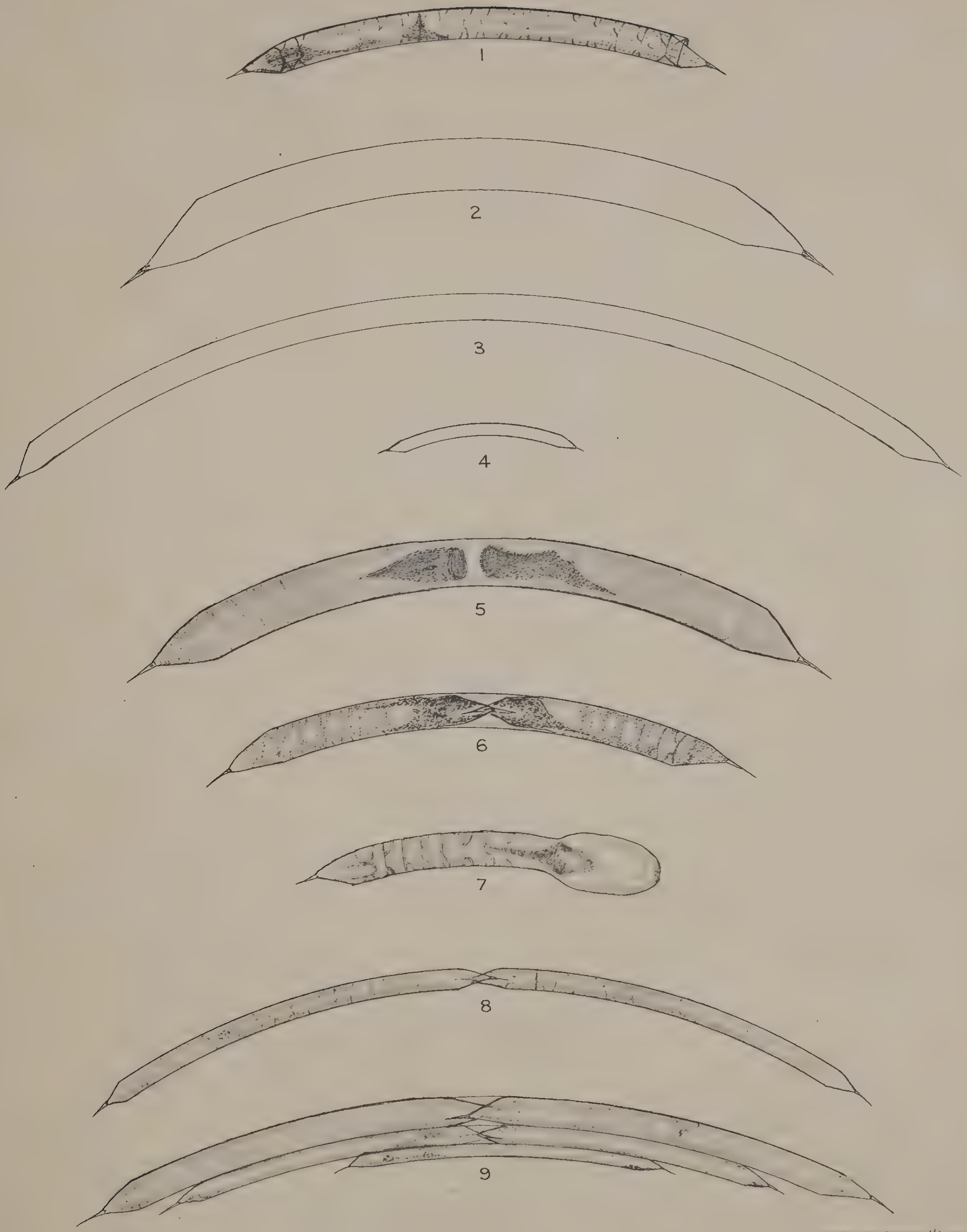
# PLATE XIV

Fig. 1. A typical individual of *Rhizosolenia curvata.*
Figs. 2–4. Outlines indicating the normal limits of size variation.
Fig. 5. Vegetative division, an early stage.
Fig. 6. Vegetative division, advanced stage.
Fig. 7. An auxospore of *Rhizosolenia curvata.*
Fig. 8. Frustules in catena.
Fig. 9. "Rafting" of individuals of different diameters.



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